THE FOUNDRY

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A Recent Visit to England.

BY S. GROVES, M. E.

II.

In the February issue of THE FOUNDRY a traveler tells of the trouble he found in getting into the workshops of Europe; and yet sums up the result of his limited experience thus:—

"Of the mechanical conservatism that we hear so much about—the spirit that will not change from hoary traditions of how the grandfathers did; because Yankees or others have new fangled notions—I am free to say there is less of it on the continent than I expected. You must go to Great Britain to find that plant in full bloom."

That sweeping allegation was made without a single illustration in evidence thereof; but then, proof was unnecessary, for, as Sairey Gamp said—"comparisons are odorous;" and to a certain class of minds, an innocent statement like that about the blooming plant, would be as "a sweet smelling savor." It reminds one of Job and his comforters. The old Emir's friends were trying to make him feel mean, and they succeeded in making him tired. Hence, with quiet sarcasm he answered: "No doubt but ye are the people, and wisdom shall die with you."

A manufacturer in Pennsylvania was warned by kind friends of the danger of his line of engines becoming "out of date;" since an improved type was being brought out by one of his competitors; and it was urged that the new engine would displace the old style, get the start and hold the market. The veteran replied, let others do the experimenting, when they have put their finished work on the market I can begin where they left off, and improve; having saved the money which they spent in experiment.

I heard it repeatedly said in Britain that the United States got ahead in the industrial world by copying and improving English machinery. Now, the Britisher, with his free trade notions of buying in the cheapest and selling in the dearest market, is buying up the best American labor-saving machines and appliances—which have in most instances been developed and perfected at great expense. With a serene smile, the manufacturer on the other side of the Atlantic will tell you that with the latest American labor-saving tools and cheap labor he has no fear of final competition in the machinery markets of the world!

In presenting my card at the various works in the North and Midlands, the fact of being a Pittsburger was never hid, and yet I was not once refused admission to the workshops. And when attempting to explain—time and again—the advantages of American foundry and machine shop appliances, I was invariably listened to, not with arched up brows and curled lip, but with respectful credulity; for, just as the sneer about "Yankee blow" has given place to respect and admiration since "Manila" and "Santiago," so, scepticism about "American superiority in mechanics" is giving place to candid expressions of belief, since the invasion of English railroads—by Westinghouse air brakes, etc.; English streets—by Tesla motors, etc.; English machine shops—by Brown & Sharp milling machines, Hendy screw-cutting lathes, Niles boring mills, etc.; English foundries—by Roots' positive pressive blowers, Tabor molding machines, etc.

Some of our modern travelers—who are great authorities on the blooming of plants—seem not to have heard of the remarkable increase in our export trade to Great Britain during the last year or two; especially in machinery. This unexpected demand for American labor-saving tools, etc., began during the great engineers' strike, when nearly every engineering establishment in the country was practically shut down.

In the great coal strike of 18— labor won; their cause was just. The engineers' strike—which terminated just before I crossed the Atlantic—ended disastrously for the men; their cause was unjust. Popular sympathy was with the men in the demand for eight hours, but when it dawned on the public mind that the trades unions claimed to dictate how many machines the men should

run, and refused to allow one man to take charge of more than one apiece, then funds fell off, and capital won. I know a firm of American tool builders, who—immediately after the Homestead strike—were offered a bonus of $1,000.00 on every machine they could build which would displace one mechanic! Automatic machines do not go on strike. The British manufacturers have learned this lesson in trade economics also, hence the demand for American labor-saving machines. The advertising columns of the London "Engineer" and "Engineering" show that the British tool builders have profited by experience; the samples they have been buying have manifestly been used to advantage. John Bull is wise in his generation, and after all "imitation is the sincerest form of flattery."

Having cleared the ground of a fallacy, which still lingers in the minds of not a few foundrymen—otherwise well informed— I now proceed to reduce generalities to particulars by describing some of the things old and new which I saw with my own eyes in the workshops of Old England.

The green fields were dotted with buttercups and red tipped daisies; the hedgerows covered with white hawthorn blossom, and a lark was singing gaily on the edge of a silvery cloud, as one bright May morn I wended my footsteps down from the little Yorkshire town of North Ormesby to the furnace and pipe foundries of Cochrane, Grove & Co., located on the banks of the River Tees, about a mile—as the crow flies—from the Middlesbrough railroad station. The plant covers some 26 acres, is one of the oldest in the Ironopolis, and when in full swing employs upwards of 2,000 men. The five blast furnaces and their equipment are among the most modern in the British Isles. Until very recently, three of them (as regards size), were the largest in the world. No. 5 is 90'-0" high, bosh 29'-0", and well 10'-0" diameter. When this furnace was turning out 950 tons of iron per week it was thought to be very wonderful; but about the same time F furnace, at the Edgar Thompson Works, of the Carnegie Steel Co., which is 80'-0" diameter, bosh 23'-0", and well 11'-0" diameter, was turning out 2,500 tons per week; and has turned out over 3,000 tons per week since then. In the English furnace, however, Cleveland ores were used, containing only some 30 per cent of iron; whereas, the American furnace was smelting Lake Superior ores, containing, say, 62 per cent of iron. Moreover, the English blast pressure was only 5 pounds; whereas the American was 10 to 13 pounds.

The English lining lasts from 11 to 1[illegible] years, the American linings about 3 years. This enterprising company were the first to use Cowper's regenerative heating stoves on a large scale, and whilst other firms were hesitating about taking a leap in the dark, and forcing hot blast into their furnaces at a temperature of 750 degrees, they were sending it in at 1,500 degrees; saving 7½ cwts. of coke upon every ton of iron produced, and succeeded in making a fortune before the others "got on to it." The series of 13 stoves, 26'-0" diameter, 50'-0" high, ranged behind the five furnaces, presented a very imposing appearance. Here they have all the modern improvements in blast furnace practice. Gjers' calcining kilns; Roots' boilers, 100" vertical blowing engines, Berryman condensers, Cameron pumps, vertical water balance hoists, for carrying the material up to the charging platform; hydraulic apparatus for lowering and lifting the bell; but, perhaps, the most interesting economy was Hawdon's slag disintegrating apparatus. This device consists of an endless chain, 40 or 50 feet long, carried over sprocket wheels at each end. On this slowly moving chain is fixed a series of shallow saucers, into which trickles the molten slag from the furnace spout. The chain—midway between the ends—dips into a tank of cold water, thus breaks up the shallow pancake of hot slag into small particles. Underneath the terminal wheel is a wrought iron truck, into this truck the saucers in their continuous journey keep depositing their slender load of brittle flakes of slag. When full the wagon is hauled by a locomotive to the river side, where it is tilted and the load of slag discharged down a shoot into a river barge, having a false bottom. This barge is towed out of the river to the sea by a steamboat, and when far from land the bottom of the barge is dropped and the slag sinks into the deep blue waters of the German ocean. A serious problem to the Cleveland ironmasters had been the disposition of the waste products; for the marshy lands on the shores of the river had been largely filled in, and the vicinage of the numerous furnace stacks was becoming disfigured by the huge, unsightly mounds of slag which the traveler sees everywhere standing out in grim relief against the sky

But necessity is the mother of invention, and now some send the slag out to sea, others convert it into cement and bricks, while at the Eston Steel Works it is utilized as manure for agricultural lands. At the adjoining Tees Iron Works, a large percentage of the molten slag is converted into mineral wool—a valuable non-conductor of heat and sound—used as a covering for boilers, steam pipes, core oven roofs and doors, packing between floors and ceilings of public buildings, etc. This was the first plant of the kind in the world. The process and machinery were invented by Mr. Charles Wood—late manager of the furnaces from which the silky, fibrous slag was made—who was also the pioneer in the investigations as to the value of silicon, as the dominant factor in foundry mixtures (see Iron and Steel Institute Journal, 1886); a theory which has been reduced to a science by Mr. W. J. Keep, of Detroit.

Across the River Tees—with its flotillas of barges, bringing in sand for the foundries, carrying out slag to the sea; with its fleets of powerful steamships bringing in ores from Spain and Sweeden; carrying out pig iron, steel, pipes, etc., to the ports of Continental Europe and the colonies—one can see from the Ormesby furnaces the extensive Port Clarence Works of Bell Brothers; the presiding genius of which is Isaac Lowthian Bell, known throughout the industrial world as the "Nestor" of furnacemen, and whose work on the "Chemical Phenomena of the Blast Furnace" is an acknowledged classic. The eight furnaces at Port Clarence are equipped as completely as those of his great rival, Charles Cochrane, on the other side of the river—who, by the way, was numbered with the mighty dead during the time of my visit. And to show that advanced English manufacturers are determined to keep abreast of the times, I may say that a well-known Pittsburg consulting engineer received a telegram from Isaac Lowthian Bell just before I sailed for Great Britain, asking how much he would charge to consult for a month; the answer was $5,000.00 (five thousand dollars); the reply from Port Clarence was "Come." And when I was inspecting the Ormesby Iron Works that Pittsburg mechanical engineer was imparting his knowledge of the latest blast furnace improvements in America at the Port Clarence works on the other side of the river. That did not look like the "mechanical conservatism" which a distinguished traveler alleges he recently found among the moss-grown industrial establishments of Great Britain.

The Melting Point of Cast Iron.

By DR. R. MOLDENKE.

In the rapid development of the art of founding into a distinct division of a great branch of applied science, one point seems to have escaped general research, not because it was not recognized, but because the proper appliances were lacking. This is the question of melting and casting temperature, a question all foundrymen deal with daily, and which for some branches of the art means either a successful cast or an utter failure.

The question of whether silicon affects the condition of the carbon contents of a casting or not is coming up again, as it does periodically, analyses by the dozen being quoted to substantiate statements made on either side, and yet we see only an occasional statement that the temperature conditions were as nearly the same as possible. What proof is there of this? The writer has taken the temperature of a ladle of iron which to the eye seemed as hot as melted steel, and yet another ladle full of iron of a different composition, which was dull red, contained the hotter metal of the two. Again from the same tap differences in temperature were found running nearly 200 degrees F. The castings made with the two extremes in this case, though of the same silicon contents, differed widely in the proportion of graphite to combined carbon for the same thickness of section.

No wonder we are told that the silicons do not play so important a part. In one of the determinations described later on, a piece of cast iron was placed side by side with some ferro-chrom, both being under the same cupola conditions. The comparatively thick piece of cast iron heated quickly and melted before the thin piece of ferro-chrom, though showing the melting heat of the iron, was thoroughly red hot. Thus it will be seen that the eye is no criterion of the degrees of heat present when they get into the high ranges.

Those who cast heavy work know the danger of pouring either too hot or too cold, and many are the devices made use of to test the heat of a ladle full of melted iron. Since these methods are empirical at best,

how will we know at least approximately the temperature of our melt? Only by a device capable of withstanding such a severe usage. In looking about for such an instrument the attention of the writer was naturally directed to the latest and admittedly the best form of a pyrometer for very high temperatures, the Le Chatelier. This consists essentially of two pieces of wire of a

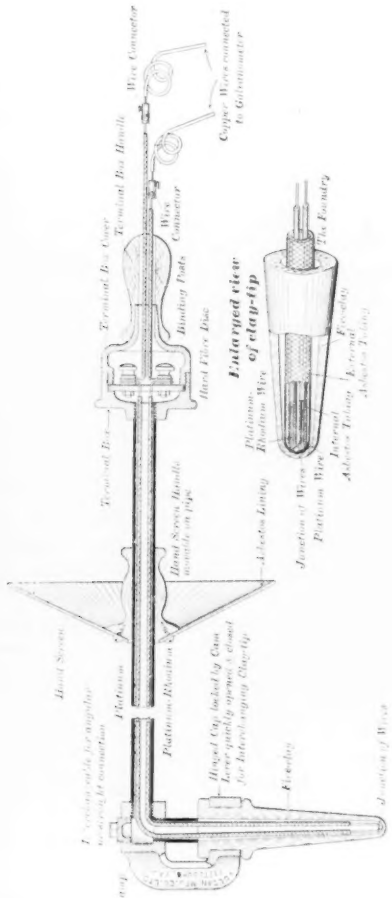

FIG. 1—SECTION THROUGH PYROMETER.

slightly varying composition, a heating of the junction of which produces a current of electricity proportioned to the degrees of heat applied. The amount of this current is measured by a suitably calibrated galvonometer, and thus we can read off the heat at any convenient distance rapidly and with a surprising degree of accuracy.

Unfortunately, this wonderful instrument, one wire of which is of platinum, the other of an alloy of platinum and 10 per cent of the rare metal rhodium, cannot be immersed directly in the melted iron—there would soon be an end to this expensive thermo-couple. The long porcelain tube which protects it when used in kilns is worse than useless in

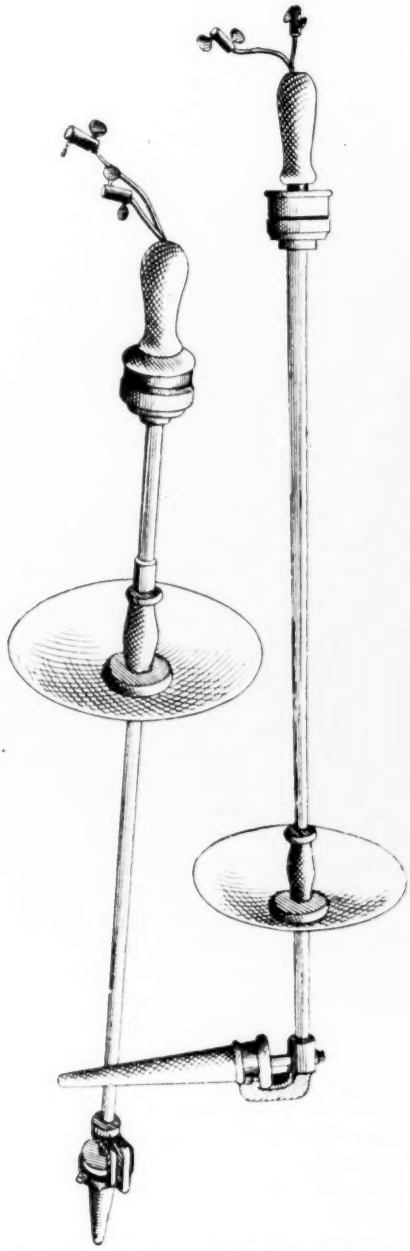

FIG. 2—TWO FORMS OF LE CHATELIER PYROMETER.

a ladle full of metal, and so at the suggestion of the writer the Pittsburg representatives, the Vulcan Mfg. Co., set about to

remedy the matter and devise some protective cover which would allow experiments of this kind to be carried out readily. The outcome, while not having the advantage as yet of an extended period of trial, was nevertheless so happy a solution that it is presented to-night for the first time and to the Pittsburg Foundrymen's Association with the hope that much of value may be learned with it, not only in our daily work, but also in connection with the many intricate problems still before us which await

FIG. 3—METHOD OF USING IN LADLE.

solution at the hands of those willing to give their time and energy to such an exacting study.

Fig. 1 shows a section through the instrument. The platinum wire will be noticed running from the terminal box through an iron pipe ending at the inner side of the point of the clay tip. Here is the button made by the fusion to the other wire of platinum and rhodium alloy which runs back, parallel to the platinum wire, to the terminal box. Both wires are covered with asbestos to insulate them from each other and from the iron frame as well as to serve as a protection in case the tip breaks while in the molten iron. The interchangeable connection holding the clay tip allows it to point out straight for use in small ladles or in experimenting, or it may come down at right angles for taking temperatures in large ladles full of metal. A third form, not completed in time for illustration purposes, has a ball and socket joint which allows the tip to stand out at any angle. A movable shield lined with asbestos protects the hand.

Fig. 2 shows two of the styles of the pyrometer, and Fig. 3 the method of using the angular form. In the terminal box are

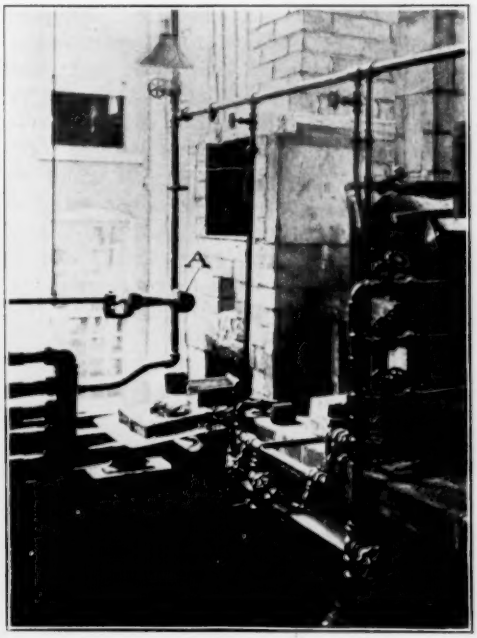

FIG. 4—APPARATUS FOR DETERMINING THE MELTING POINT OF CAST IRON—SIDE VIEW.

placed the connections which allow wires of any convenient length to run through the handle and connect with the galvanometer. The galvanometer itself is a "D'Arsonville," specially gotten up and calibrated for industrial purposes. The original form with the reflecting mirror, and capable of reading to one-half of a degree at these high temperatures, was found too cumbersome and delicate for factory use.

The sensitiveness of the couple, even though protected by a refractory material, is such that plunging it cold into the melted iron the correct reading is obtained in one minute and three-quarters. When properly

heated up to redness beforehand, however, this time is reduced to not many seconds.

It would be beyond the scope of this paper to show the many uses to which such an instrument can be put in the steel and iron trade. On the question of annealing alone it will pay for itself in a short time, and when its capabilities in foundry practice come to be investigated and generally understood, one more safeguard will be added to those already helping us to increase the efficiency of our plants.

We come now to the subject matter itself. You will all remember the recent discussion on the melting of white and gray irons, Mr. West's elaborate experiments confirming our daily experience. Yet the correctness of the conclusions were questioned, and while the peculiar phenomena observed in the behavior of carbon with iron make any positive statements rather hazardous, yet the melting down of a lump of iron, and taking its temperature while doing so, should stand as a final determination of its melting point as viewed from the entirely practical side of the question. This is the consideration we have to deal with daily in cupola and furnace.

The material experimented with was gathered for several years, some of it being furnished by Mr. Jos. Seaman, Mr. Thos. D. West and Mr. J. E. McDonald, members of this association, and the especially interesting alloys by Mr. R. McDonald, of the Crescent Steel Co.

There were 48 pig irons, embracing both foundry and Bessemer brands as well as softeners, made with coke and with charcoal, both cold and warm blast. Seven of the cast irons were of the shape seen at A, Fig. 4, being melted right from the tip. The balance of the 15 specimens were of the sand and chill rolls made by Mr. West in his recent experiments. Two steels and nine alloys of chromium, tungsten and manganese with iron, complete the list of 73 specimens.

The melting was done in an assay furnace converted for the time into a cupola. Fig. 5 gives a front view of it while in full operation. A jet of steam entering the stack in the side near the top induced the blast, the air being drawn in all around the bottom. In this form it is really the "Herberz" cupola of European fame and excellent for small diameters. A hole was broken into the wall just below the charging door, which must be kept closed when not used. This hole allows the introduction of the pieces of pig iron, etc. After heaping up enough coke to last for some time, the piece of pig iron (of full section and about five inches long), was driven into the bed, surrounded by incandescent coke and the opening closed with a tile. After it was red hot the tile was removed, the pyrometer inserted and pushed against the center of the pig where the borings were taken for the analysis. The temperature as registered by the pyrometer rose rapidly, then more slowly, remaining stationary while the iron melted slowly. Then as the point finally became uncovered the temperature jumped up, going above 2,600 degrees F. In this way the results noted in the tables below were obtained.

TABLE 1.—PIG IRONS.

No.	Melting Point.	Combined Carbon	Graphite.	Silicon.	Manganese.	Phosphorus.	Sulphur.
1	2030° F.	3.98	....	14	.10	.220	.037
2	2040	3.90	....	.28	.11	.216	.044
3	2040	3.74	.14	.38	.16	.172	.032
4	2070	3.70	....	.26	.09	.198	.033
5	2100	3.52	.54	.47	.20	.200	.036
6	2040	3.48	....	.36	.09	.240	.040
7	2055	3.22	.68	.71	.09	.142	.038
8	2010	3.21	.20	.45	.18	.198	.037
9	2110	2.28	1.14	.42	.13	.185	.026
10	2140	2.27	1.80	.45	1.10	1.465	.032
11	2150	2.23	1.58	.42	.16	.415	.045
12	2170	1.96	1.90	.75	.63	.097	.028
13	2170	1.93	1.69	.52	.16	.760	.036
14	2170	1.87	1.85	.56	.45	.713	.027
15	2150	1.84	1.95	.56	.34	.175	.022
16	2190	1.72	2.17	1.88	.54	.446	.028
17	2200	1.69	2.40	1.81	.49	1.692	.060
18	2230	1.54	2.08	2.02	.39	.632	.062
19	2190	1.49	2.26	2.54	.50	.349	.038
20	2210	1.48	2.30	1.41	1.39	.168	.033
21	2190	1.47	2.63	.89	.48	.164	.037
22	2190	1.36	2.41	1.65	.32	.160	.038
23	2210	1.31	2.70	1.25	.76	.170	.022
24	2210	1.31	2.40	1.69	.46	.085	.030
25	2230	1.24	2.68	.65	.26	.201	.020
26	2230	1.23	2.70	1.20	.37	.299	.022
27	2230	1.12	2.66	1.13	.24	.089	.027
28	2200	.90	3.07	1.09	.33	.176	.014
29	2230	.87	3.10	1.34	.42	.158	.030
30	2210	.84	3.07	2.58	.47	2.124	.051
31	2260	.83	3.26	1.97	.59	.210	.018
32	2230	.80	3.22	1.30	.59	.172	.042
33	2250	.80	3.16	1.29	.50	.218	.020
34	2250	.80	2.89	2.21	.25	.411	.041
35	2250	.67	3.60	1.32	.20	.205	.020
36	2240	.59	3.15	1.50	.61	.094	.032
37	2230	.47	2.84	2.19	.65	1.518	.042
38	2250	.38	3.43	2.44	.57	.422	.048
39	2250	.35	3.44	2.07	.28	.448	.039
40	2260	.35	3.70	3.29	.82	.501	.038
41	2260	.24	3.48	2.54	.30	.060	.020
42	2280	.13	3.43	2.40	.90	.082	.032

SOFTENERS, FERROSILICONS, AND SILICO SPIEGEL.

43	2190	3.38	.37	12.30	16.98
44	2040	1.82	.47	12.01	1.38
45	2090	2.17	.72	10.96	1.34
46	2155	1.35	1.60	9.40	.32
47	2145	1.57	1.36	8.93	.39
48	2170	1.77	1.80	4.96	.39

It took much patience, a loss of a few samples, and a number of broken tips to accomplish all this, but on the whole the results given are as good as could be gotten under the conditions prevailing. The coke burning up would let the iron drop a little, and a failure to adjust the pyrometer to suit (the opening being closed by a piece of sheet iron, to prevent undue cooling by air drawn in), meant a break in the tip, which, while not affecting the results, caused subsequent delay and trouble.

The folowing general observations were made: The white irons held their shape, the iron running from the sides and bottom freely, leaving smooth surfaces. The gray irons became soft, dropped in lumps, leaving a ragged surface. Ferro-manganese samples became soft and mushy, exhibiting a consistency of putty before finally running down. Ferro-tungsten behaved in the most marked way. As it melted it acted like white iron, but instead of chilling quickly it ran through the coke, coming down the spout in thin streams like white hot quicksilver, only setting after collecting in a pool in the pan of sand.

The cupola was fluxed heavily with fluor spar to take care of the ash, for it was a case of a furnace full of incandescent coke and only one piece of iron in it. The accompanying tables give the results.

For a better comparison of the melting points of the same irons cast into sand and

TABLE 2.—CAST IRONS.

No.	Melting Point.	Com. Carbon.	Graphite.	Silicon.	Manganese.	Phosphorus.	Sulphur.	Remarks.
49	2000°F.	4.67	.03	.57	.32	.266	.044	Cast into chill roll (Mr. West).
50	1990	4.20	.20	.63	.33	.254	.040	" " " "
51	2010	4.08	....	.89	.06	.287	.040	" dry sand.
52	2000	3.90	.16	.75	.66	.240	.030	" chill roll (Mr. West).
53	2030	3.62	....	.72	.14	.093	.026	" dry sand.
54	2030	3.48	....	.47	.09	.190	.032	" "
55	2040	3.40	....	.42	.07	.196	.029	" "
56	2170	1.63	2.27	1.46	.50	.092	.032	" "
57	2210	1.60	3.16	.59	.25	.271	.048	No. 48 in sand rolls (Mr. West).
58	2250	1.57	2.90	.66	.31	.237	.040	No. 49 " " " "
59	2240	1.22	2.66	1.69	.47	.274	.037	Cast into dry sand.
60	2250	1.20	2.90	.75	.66	.248	.030	No. 51 in sand rolls (Mr. West).
61	2260	.17	3.57	2.09	.43	.272	.042	Cast into green sand.
62	2080	1.95	1.28	11.64	.98	...	...	Remelted ferro-silicon No. 5, cast into chill roll (Mr. West).
63	2080	1.81	1.36	11.70	1.00	...	...	Remelted ferro-silicon No. 5, cast into sand roll (Mr. West).

TABLE 3.

No.	Combined Carbon.	Graphite.	Fracture.	Melting Point.	
57	1.60	3.16	Gray	2210°F.	
49	4.67	.03	White	2000	same ladle.
58	1.57	2.90	Gray	2250	
50	4.20	.20	White	1990	same ladle.
60	1.20	2.90	Gray	2250	
52	3.90	.16	White	2000	same ladle.

TABLE 4.—ALLOYS AND STEEL.

No.	Melting Point.	Carbon.	Silicon.	Manganese.	Chromium.	Tungsten.	Remarks.
64	2450°F.	1.18	.21	.49	....	....	Steel.
65	2350	1.32	.29	1.27	3.40	6.21	Steel.
66	2280	....	....	....	....	39.02	Ferrotungsten.
67	2240	....	....	....	....	11.84	Ferrotungsten.
68	2255	5.02	1.65	81.40	....	....	Ferromanganese.
69	2210	6.48	.14	44.59	....	....	Ferromanganese.
70	2400	6.80	....	....	62.70	....	Forrochrom.
71	2230	6.40	....	....	19.20	....	Forrochrom.
72	2260	1.20	....	....	19.10	....	Forrochrom.
73	2180	1.40	....	....	5.40	....	Forrochrom.

into chills, as made by Mr. West, the accompanying table is given:

The tables of the pig and cast irons have been arranged according to their combined carbon contents, for it is evident that with few exceptions the melting points increase as the combined carbon goes down, this being the case independent of the amount of graphite present. One could hardly expect any-

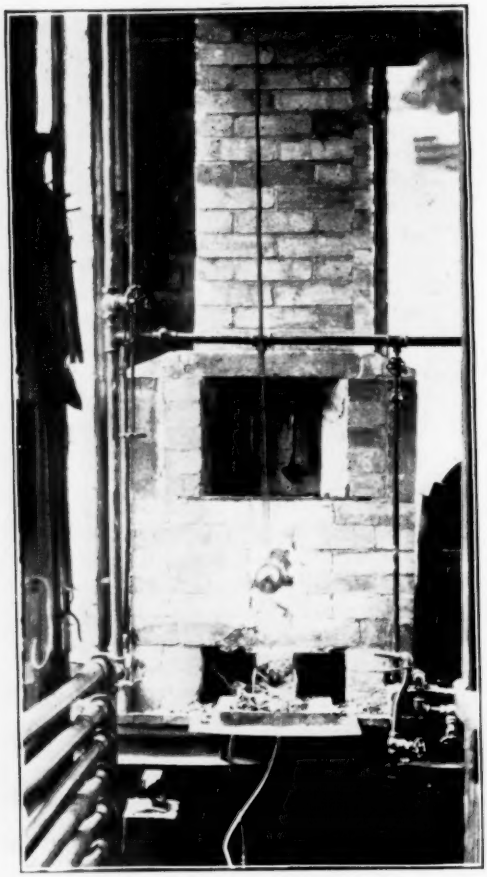

FIG. 5—APPARATUS FOR DETERMINING THE MELTING POINT OF PIG IRON—FRONT VIEW.

thing else for that matter, gray cast iron being really a steel with a lot of mechanically mixed graphite, and white iron a combination of carbon with iron. Alloys melt at a lower temperature thany any of their constituents, and so also white iron, really an alloy of carbon or some carbides of iron with iron, should melt sooner than the purer iron in the gray variety.

The fact, however, that steel melts at a much higher temperature than the grayest of irons in the table, shows that there are other considerations that are not to be overlooked in studying the molecular physics of cast iron. The principal reason for this lowering of temperature is the supposed solution of the graphite in the iron before actual melting takes place. To what extent this occurs and under what circumstances is not known, but may account for the difference in the melting points of steel and gray iron.

Again, in melting steel in the cupola, commercially, an absorption of carbon from the fuel takes place, the melting point is doubtless lowered a little, and the results obtained are tangible, even though care must be taken to get the whole of the charge down before pouring. In the air furnace the steel absorbs carbon by contact with the pig iron charged and melts off, the wasting of wrought iron or steel poking bars used for rabbling giving evidence of this occurrence.

The writer is especially pleased to see the full corroboration of Mr. West's elaborate experiments with the melting of white and gray irons. The contrast is remarkably sharp, and on the whole it shows us that science and practice go hand in hand admirably, no matter what the field may be. Whatever theories may develop regarding the melting of iron, whatever the effect of high or low phosphorus, silicon, manganese and sulphur, may be shown to be on the melting point of an iron eventually (the present series of irons not being well enough adapted for this phase of the question), the results here given are, it is hoped, of sufficient value to stimulate further research of practical value to the founders of cast iron.

Cataloging Patterns.

BY I. B. THOMAS.

As a foundry grows in age and size one of the greatest problems met with is how to properly store the numerous patterns. This involves not only having a suitable fire-proof building in which to keep them, and one where they will be free from moisture, but an easy method of locating each individual piece, no matter how small. They must be so arranged that each one can be gotten at without removing half the others and finally have to give the job up and make a new one because you "cannot remember where you last put it."

In our shops we have something like 28,000 patterns for iron, brass, bronze, etc.,

and are just completing a task which if started in time is not difficult, but with 19,000 miscellaneous patterns, besides our

Our first move was to number the sections and shelves in the pattern storehouse. This building is 50 feet by 100 feet, two (2)

PATTERN NUMBER.	METAL.	SECTION.	SHELF.	WHEN MADE.
23159	Brass.	932	C	7-14-96

DESCRIPTION: *Tee, used on steam brake.*
Millwood C. & C. Co., Eng. No. 2.

TRACING NUMBER.
Made from Sample.

FIG. 1.

regular line of work, more or less carefully recorded in numerical order in books, which will wear out, and no means but memory to locate them on their proper shelves, it be-

stories and a loft, with a platform midway of each story, really making five (5) stories. Shelves about five or six feet deep extend around all four (4) sides and there are two

Locomotives—Foreign Roads.
Tee, steam brake.
Millwood Coal & Coke Co., Eng. No. 2.

PATTERN NUMBER. 23159

REMARKS.

FIG. 2.

comes quite a herculean task to catalogue and arrange them, though one which will never be regretted.

(2) rows in the center. These we divided into sections of about six (6) feet in length and numbered them in a similar manner to

houses on the opposite sides of the aisles, giving letters to the shelves. In order to keep as much uniformity as possible, sections directly above one another have the same number, except a new hundred, so that we know that all sections under number 200 are on the first floor, 200 to 399 are above the platform on this floor, etc., and above 800 in the attic.

We believe for this class of work there is no system of cataloging so adaptable as the card system; one of the greatest arguments in its favor arising from the fact that patterns are so frequently altered to suit other work or possibly destroyed. It is very desirable to have such information regarding them where it can be found. With a book your space is very limited, but with the card system if necessary a second one can be given to a single pattern in order to have all the information together. Indexing a book is always unsatisfactory, as you are sure to fill up the allotted space for some particular letter long before the others, while with the cards one can expand indefinitely, putting in as many subdivisions as convenience demands.

As our books were in almost constant demand in the foreman's office, it was necessary to copy on sheets such records as we had of our patterns, arranged in numerical order.

We then started in our attic, took out each pattern, checked it with the sheet, added any additional information collectable and assigned the patterns and core boxes, if any, to a particular section and shelf, marking this on the sheet, and also stenciling it on the pattern as :—932-C. This last is very essential to prevent confusion when pattern is returned from the foundry.

From these sheets two (2) cards similar to Figures 1 and 2 were filled out for each pattern. Number one (1) is for the numerical catalogue and contains all the information ordinarily required, including its number, kind of metal of which the casting should be made, location, date when made (by which we are able to obtain its cost by reference to our time book), the description of the article and, lastly, the model from which it was made. Ordinarily a drawing number would appear here, but in this case the casting was evidently to replace a broken one, and the other pattern was made direct from this. Card No. 2 is for the index proper. This is where great care and good judgment must be exercised, as on the proper wording of this card depends the usefulness of the catalogue. In the case cited anyone hunting this pattern would naturally turn first to Locomotives, then Foreign Roads and finally to Tee for Steam brake. He would then have to consult the numerical index and under No. 23159 would find the location of the desired pattern, as:—section 932, shelf C, after which any person could lay his hands on the pattern with little difficulty.

If a pattern is ever destroyed we will remove its numerical card (Fig.1) to a special drawer in the cabinet and mark the fact on the index card. The number can then be filled by a new pattern. The hole in the lower portion of the card is very essential. A brass rod is run through this and locked in place. One man is then made responsible for the catalogue and it is impossible for the several others who have occasion to make use of it to forget to replace a card.

We have a special place where we store our snap boards and have employed a simple but effective method of locating these. There are about 435 boards, with numbers ranging from one (1) to 28,000, just as chance determines.

After properly sectioning the shelves and numbering them we procured a book of just 100 pages, numbered from 0 to 99, and use the system of indexing by the last two (2) numbers of the pattern. Suppose we wish snap board No. 1626, we turn to page 26 and find in a second 1626—C—6; so we know it is section C, shelf 6. Boards 26, 426, 25926, etc., would also be on this same page, but as there are but 435 numbers distributed through the 28,000 it is seldom one has more than eight (8) or ten (10) numbers on one page. This system is a splendid one for similar cases where you have a record to keep which involves a comparatively few numbers scattered promiscuously through several thousand.

"Dirty Iron."

By P. R. RAMP.

The above topic is one very often discussed by the molder. Should he, through carelessness, make a dirty mold, very often when told of the bad work, his excuse will be "dirty iron." The way I understand the

expression "dirty iron,' or what the average molder means by the same is this:

The iron when it comes from the cupola is dirty, the impurities being thoroughly mixed with the liquid metal do not rise to the surface, and in most cases the mold is poured, the dirt going in with the iron, it being so well mixed and failing to rise to the surface, where it could be skimmed off, causes a dirty casting. Hence a most careful molder is liable to loose his work or make it very dirty and not be at all to blame. Now it is amusing how a molder will cling to this theory like a drowning man to a straw, with the assurance that it will excuse him and make him appear as innocent as a babe as to the cause of the dirty work he has produced.

Although there may be cases of actual dirty iron, the careful molder is very seldom troubled with the same. He will undoubtedly hear his fellow-workman complaning about dirt in the iron, but if he makes a clean mold, and insists on skimming every time he pours, he will have no trouble.

In skimming a ladle of melted iron some men seem to think it is necessary for them to use the skimmer like their wives do an egg beater. Such skimmers are liable to make some one cry out, "Dirty iron!" The object of skimming is to hold back all the impurities that rise to the top of the ladle, such as slag, etc., thus preventing them from entering the mold. The fashion molders have, of holding the dirt back with the skimmer until the mold is half poured, then taking it away to light the vents, causing the other half to be poured without skimming, very often is the cause of dirty work. If a man is pouring a mold that must have the vents lighted he must have one to skim and one to light vents.

A short time ago one of my molders was making some lower shells for a gas meter, weighing about 500 pounds, very light for their size, shaped like a kettle, made bottom side up, and poured with two ladles. One of the castings turned out to be very dirty. I took him out into the cleaning room, showed it to him and asked him what was the matter with it, and how all that dirt got into it. He replied, "Dirty iron," and explained that the dirt, being in the iron and not rising to the top of the ladle, so it could be skimmed off, was poured in the mold, causing dirty castings, thus making me responsible for his bad work. He might have gotten off on this frail excuse had he explained how I happened to give him dirty iron in one ladle and clean in the other, for according to his theory that was the case, as there was slag or dirt on but one side of the shell, right above the gate, while the other side had not the slightest indication of dirt or slag. My advice to him was to have a good skimmer, and to all "dirty iron" molders the same.

Chilled Roll Making.

By C. F. LOGAN.

A late writer, ascribing certain causes for the frequent failures of chilled rolls, has awakened considerable interest in the subject, and a still further discussion of the topic may prove profitable. Some able writers have given the matter much attention, and by elaborate experiment have adduced results seemingly at conflict with prevailing theories among manufacturers. The experiments indicate that the inner, grey body of the roll is in a state of tension, and that the outer, chilled portion is in a state of compression. The author is right in his position, and, though his experiments may contradict the theories held by clerks in roll-foundry offices, and foundry officers who have inherited their positions, yet, to practical men in roll-making, the discussion sounds like a school-boy discussing astronomy. I believe in the spirit of emulation and rivalry; but it may be carried too far, and, as often happens, impracticable ideas may be put forth.

There is a growing tendency among chill roll manufacturers to deprecate the manner in which the roll is worked in the mills. We have also been informed by lucid illustrations, conflicting discussions and suggestions of co-operation between mill managers and the foundrymen, how and to what extent we may possibly ascertain causes of and reduce breakage. A certain writer (manufacturer) complained of lack of skill in roll foundries and mills, and attributed many losses in this line thereto. He especially points to the breaking of necks, but (alas) he fails to mention that very often when a neck breaks a portion of the body still remains attached. The question arises, may it not be possible that such breakage

was caused by internal stresses, or the irregular expansion of the chilled portion of the roll. There are many roll-makers who labor under the impression that because they possess formulas for mixtures for making rolls they are fully competent to embark in the business, though without practical knowledge of the metallurgy of cast iron. This is a great mistake. We meet with many difficult problems in chill roll-making—the melting, molding, preparing the chills, and, most important of all, judging the temperature of the iron before it enters the mold. Unless his knowledge is broad in all these he cannot master the difficulties that will arise. He may dodge them for a time, but they constantly reappear, and sooner or later his failure to overcome will win for him a reputation of incompetency.

To fully understand, and successfully produce a chill roll, we must study the physical and chemical changes that take place immediately the iron is poured, for upon these, and the conditions which we allow at this moment, depends the life of the roll in operation.

The chill roll, though manifestly of the same constitution, is possessed of properties different from those of the sand roll, being in many respects much more like two metals united by a welding process. The inner portion remains fluid, similar to iron cast in a sand mold, with comparatively the same shrinkage in cooling—one-eighth inch to the foot—whilst the outer, chilled portion seems to vary in shrinkage according to varying conditions in casting operations, shrinking usually twice as much, the elements remaining the same throughout, except that the carbon is more combined in the chilled portion.

Chill roll founders still follow the same general methods that prevailed in my boyhood days, except that the straight gate is now generally preferred to the ring gate formerly used.

Many founders who have hitherto appeared indifferent have lately manifested an active interest in that very important feature of chill roll-making, viz., uniformity in depth of chill. This is particularly true of Pittsburg and vicinity.

I have no doubt that such rolls, if other precautions necessary to reduction of internal stress have been observed, are far superior to the majority of rolls made.

And now the science of chemistry has been invoked to explain the phenomena of this question. It is absurd to think that chemical composition differs in a roll that gives good service from one that cracks, both being cast from the same ladle of iron, when it is known that because of slight variations in methods of casting and cooling, distressing phenomena may ensue, visible to the expert, though unnoticed by most manufacturers and mill operators.

It is erroneous to think that an analytical assay would discover the cause of physical weakness. Again, to claim that no material difference in chemical and physical properties pertain to rolls of different makes would be wrong and misleading. However voluminous analytical tables, from assays taken of borings from different foundries average but a slight difference in proportions of sulphur and phosphorous. It is therefore conclusively evident that the roll is neither stronger nor weaker, as influenced by chemical content, when the hardness and depth of chill are the same. Why the name chemistry is used else than for advertising purposes I fail to see.

As a metallurgist and chemist, I appreciate the efficacy of chemistry as a method in arriving at the best solution as to mixtures; but I sometimes am in a quandary as to which of the various methods for testing is, after all, preferable, chemistry, judging by fracture, as of old, or by shrinkage of the test bar. The three, at any rate, sometimes seem to me as the shells in the shell game, played between the furnace operator and the foundryman!

Now, as mentioned above, upon the preparing of the chill mold and the methods of casting and cooling depends the life of the roll in use. Included in these are the manner of conducting the "heat," allowance for uniformity in expansion and contraction, etc. The tensile strength has very little bearing on the question, for any roll will stand the strain in normal tin-plate rolling. Investigation will easily prove that roll breakage is due to improper education of men in foundries and mills, and by incompetent managers who so often complain of unskillfulness in their employes, and who harass the latter by insisting upon impracticable methods.

"Too bad that everybody doesn't know where THE FOUNDRY is published.

"J. D. SMITH."

Improved Ribbed Flask.

The illustration shows the improved ribbed flask, made only by the Brass Founders' Supply Company of Newark, N. J. It has been on the market about three years, superseding the old style of plain bevel flasks in most of the large foundries in this country and some in England. These flasks are accurately milled, an improvement on the old way of planing, as every machinist has proved the impossibility of planing a light, thin casting, such as a flask, without springing out of true. The company makes its own machinery from designs of its own invention and is prepared to make flasks and other goods at a much less cost than by the old slow process of planing. This flask is the same shape as the old style of plain bevel, with the addition of the ribs, which greatly strengthen it, prevents shifting and thus produces more perfect castings. The flask is fitted with steel pins and made interchangeable. In pressing with molding machines they have not been found to spring. A large number are now in use where compressed air is used for ramming, and no report of any failure to stand the presure is heard. Besides flasks, the Brass Founders' Supply Company make a full line of foundry supplies, including furnaces, core ovens, drying stoves, wood clamps and molding boards, also grey iron castings to order.

An Inquiry—Metal Borings.

The writer some years ago filled an order for a lot of hollow polished rolls, about two inches thick, a fine grained finish being very desirable. It was accomplished very satisfactorily by melting cast iron borings.

The company owned the right for charging the borings in a cast iron case, and the first cast was made by charging about a ton of the packages, after the general heat, running it into pigs, then charging them the next heat for the rolls with a small per cent of soft pig, the boring pig showing a white corner and likely to "worry" the turning tool.

In charging I noticed that the first case fell into the red coke bed very nicely, but when the second fell the collision broke both, and probably not one case in the charge escaped a smash, but was very evidently a great improvement over shovel charging, as the resulting pig astonished the deponent. After this first experiment I "ciphered out" a far better trick for package charging, and very cheap, say under two cents per 100 pounds, outside of labor, and never a break of package in charging with an eight or nine foot drop to the bed.

My object in this inquiry through the live FOUNDRY—which I find in every dingy little foundry office—is to get a general expression about the need of melted borings in the trade for fine grained, polished articles, easily machined, and for experience in melting them by others.

Any experiments in this line would be interesting, especially as to the percentage of loss by the different systems of charging, which I never tested, but was always surprised at the large yield.

The old saying was that when charged with a shovel they all "go up the chimney;" the true theory doubtless is that the great amount of surface exposed to the oxidizing atmosphere results in their being "eaten up" or converted into oxide of iron during the heating to a melted state. If the needs of the trade justifies it I can easily introduce the very cheap system experimented with so successfully.

Borings need not necessarily be melted a second time. I continued the twice-melting practice partly to get a uniform grain and partly to place the extra slag developed by melting borings at the last of the heat.

ENQUIRER.

Cast Iron Columns.

At the convention of the German foundrymen, held at Heidelberg, September 13, the following resolution was adopted on the report made by Dr. Kusch as to the casting of iron columns for structural purposes:

"Columns cast in vertical molds do not offer any more guarantee for uniform strength of wall and solidity than those cast in horizontal molds, and the latter are not inferior in quality to the former if cast with the same care. The determination of uniform strength of wall by boring holes in the columns, and a pressure test to twice the maximum burden the column is to bear offer a fully sufficient proof for the quality and strength of the column."

The building inspections in several German cities still adhere to an old ordinance, according to which none but columns cast in a vertical mold can be used in buildings, but the convention took a different view, declaring that, for the casting of pipe, vertical molds were to be recommended. Columns, however, should be cast in a horizontal mold, with the core secured by supports. As in most cases the columns are provided with foot and head pieces of larger diameter, immediately after the pour space should be made to allow for shrinking, by removing the sand, which can hardly be done in time with vertical molds. While with a standing mold in pipe casting, the impurities go into the head which is cut off anyhow, they enter, in the case of a standing column mold, the head piece, and affect at a most important place the carrying power of the column.

Useful Foundry Hints.

By R. D. MOORE.

In THE FOUNDRY of November 1897 will be found an interesting article under the heading "Why Does a Chilled Roll Crack in Cooling?" by C. F. Logan. I don't recollect seeing any replies, and there certainly was room, after reading the many silly suggestions given him about preparing the chill, etc., many of them doubtless intended to mislead.

I had a very limited experience, years ago, having made a few 20-inch and many 10, 6 and 5-inch chilled rolls. In preparing the chill I heated them sufficiently to insure them against moisture, then rubbed them well with an oiled rag, sometimes adding a very little blacklead to the rag at the last, believing that the melted iron should meet the chill as near as practicable.

One piece of advice Mr. L. reports as having been given him is worth considering, as it probably approaches the truth, but don't quite get there. He says the cracks in the rolls are explained by the chemist to be due to too strong iron, or iron having too great shrinkage.

Nearly all late writers and mechanics appear to have overlooked the old classification of cast iron as red-short and cold-short, the latter being the strong metal. Rolls made of it cannot stand the stretching made necessary by the chilled skin being rapidly cooled and still prevented from shrinking by the pressure of the fluid iron inside the shell, holding it against the chill. With a two-foot neck and a two-foot feeder the pressure, at top of chill, of the fluid iron would be nearly 13 pounds to the inch, or, to be exact, 12 8-10 pounds.

The remedy for these splits in chilled rolls appears to "lie right before us;" reduce the red-short by adding the cold-short property in the mixture until the necessary red toughness is obtained.

Canon bronze, nine of copper to one of tin, a very strong metal, is very red-short. Does this characteristic not belong to all the metals? is a question I asked through a mechanical magazine years ago. No answer came.

Another hint, having a very strong family resemblance and relationship to the above, can be given by describing an order filled. A round plate, somewhat like the well-known marble rubbers, 9 feet diameter by 3 inches thick, a stout hub and a row of 1½-inch square mortice holes running from near the edge spirally to the hub to carry steel rake teeth for crushing bones, was the character of the job. The former casting, made in another city, had broken, doubtless mainly due to shrinkage strain, and very strong iron was demanded in this case.

Having a lot of railroad wheels on hand, a large per cent of them went into the charge. The casting was very carefully center-cooled. In the morning a crack was found at the edge, running in five inches to the outer hole, and it required considerable talk to convince the general manager of the foundry, a millwright, that it was a very strong casting, and it was that strong iron that caused the crack, and that the pres-

ent strain was in opposite direction to the strain that caused the crack. The foundry company insured the casting's strength and it stood many years of hard service.

The simple explanation is that the strong red-short iron could not stretch to accommodate the more rapidly cooling edge of the plate. If weak, cold-short iron had been used no cracks would have appeared.

Another hint, having a more distant family connection. A cog wheel, when split with sheet iron or cores, should not be allowed to separate at the rim in cooling, as it is liable to do if not strongly united with cast iron outside the splitting blade or at the rim.

The shrinkage takes place earlier in the rim and for that reason necessitates either a stretch or a break of the rim. A separation of the rim alters the pitch, which is most sure to spoil the job.

Pulleys also shrinking still more irregularly when cast from whole patterns and split with wrought plates, etc., will tear apart and gape from early cooling of the rim if not attached with strong cast iron connections. It is a fortunate circumstance that this very weak point at the split is the first to cool, getting strength to compress the softer spider in making the necessary readjustment of the sizes, due to the irregular time of shrinking.

When pulley's are cast from half patterns, the rim cooling faster than the spider, shrinks more, becoming too short to meet; the rim pattern should therefore be more than a half circle to compensate for extra shrinkage.

The half pulley throws some light on the question of the philosophy of the shrinkage strain that breaks a pulley.

In a whole pulley the two contending systems of time shrinking are tied together, while in a half pattern they are both comparatively free to "have their way."

The Cast Iron Column in 1872.

BY JOHN C. KNOEPPEL.

Being a close reader on all matters pertaining to foundry work, and especially your valuable journal, THE FOUNDRY, where so much real good matter is put in print, I thought, while reading an account in this month's issue under the heading "The Cast Iron Column," of years ago, when I was working at the trade, and at once became interested. For, as the saying is, that class of work was one of my "pet jobs" while at work in New York City in the seventies.

Referring to the question of testing columns, when my father was in the foundry business in Harlem, N. Y., the work was principally house or building work, and among other things, the cast iron column was the leading work; but at that time we considered columns the best paying jobs to be had for the molder, and as I was after good money I tried to make that branch a study and to become efficient in that line. My father having the business, naturally gave me a good chance to take advantage and develop that line of molding and casting.

We had a very large order for square columns—16x16—12x16—6x16—and about 14 feet long, being paneled on three sides, the backs being open at different points, the thickness through the panels being about ⅝ of an inch, the margin about 1 inch thick.

The specification called for testing of the columns, and at that time the Jackson Architectural Iron Works, East Twenty-eighth street, New York City, did the testing, they being the only parties that had a testing machine, for which a fee was charged.

These columns were tested to 45 and 50 tons, and in some cases up to 90 tons—where it was called for—and as a rule were tested to one-third more than the column was required to bear. If they stood the required test they were marked by the proper authorities and were then allowed to be put in the building. Another feature of cast iron column was in the molding with a green sand core for square, and in some cases in the round columns. We thought it a good job to turn out a smooth, straight column. It will be seen, therefore, that the matter of testing the column has not been altogether overlooked in the past, though tests of to-day are conducted on a much larger and more scientific plan, and we are able through the medium of chemistry and analysis to get the correct results. Still, under the old plan of testing, a crooked column stood a very poor chance, as it would bulge outward. This was about twenty-six years ago, and in looking about I have seen but little improvement in column molding. There are some shops of to-day that are using dry sand cores when green sand might be used, and made in less time, all things being con-

sidered, and much cleaner work in the foundry. To facilitate column molding requires a good rigging, both as to flask and core box, and such are not costly either. The flasks are of two kinds—one that is bolted in the pit, and one to be molded on the floor. I prefer the pit plan. The core box is so constructed that any size of core can be made from it, large or small, or of any length. It is called a stationary core box, as it remains in position at some particular place within reach of the foundry crane.

With regard to the matter of testing of columns, it has not been ignored in years gone by, and the cast iron column will probably remain with us for some time to come.

Dowel Pins in Patterns.

A writer in an exchange says, "The sticking of dowel pins is a source of annoyance to a foundryman, and one from which he really ought to be free, for it reflects directly back to the pattern room, and, although a little thing, it is one about which a few words may not be amiss."

A few words ought to be sufficient; yet, some thousands of foundrymen have uttered not a few words in protest against this intolerable nuisance with but little progress toward its abatement.

Very often a pattern, made in halves, comes to the foundry and the molder is obliged to use a clamping iron to pry it apart; which, having done, he finds the wood pins to be about five-eighths inch long, of uniform diameter throughout, the ends being roughly rounded. The molder has nothing but a pocket knife to whittle the pins down with, and he does the best he can with it, but he usually takes off more from one side than from the other, and ends up by getting it too small, and so, the pattern will shift, and an imperfect casting is the result. Whose is the fault? Unquestionably, it lies at the door of the superintendent. If the foundry man goes to him with the pattern, he will meet with a repulse. It is a small matter (in the superintendent's opinion) and "a foundryman doesn't amount to much who can't correct a little thing like that." This is all very true—a foundry foreman who cannot correct a thing like that does not amount to much. And, likewise, a superintendent does not amount to so much as he ought, who will not go to the proper place and correct, once for all, a little thing like that!

We have in mind a case that will serve to illustrate the matter very aptly. The company was manufacturing minor agricultural implements, and the traveling salesmen complained that the adjustment of the various parts of the machine was so defective that they were obliged to spend much time, in the field, when exhibiting, in order to get the machine into good working order.

The matter was brought up in the presence of the president, the superintendent and the foundry foreman. The superintendent undertook to sink the question out of sight by ejaculating that "Them damn agents didn't want to do nothin' but set in a arm chair at the hotel an' draw their salaries, damn 'um.' But the foundryman had the unheard of temerity to suggest that the place to complete the manufacture of the goods was in the factory, where there were men and tools for the purpose. The president instantly seconded the motion, and with such emphasis that the trouble was at once corrected.

Returning to the matter of dowel pins, it is a question deserving of more consideration than is usually given it. The wood dowel pin for patterns is out of date. Iron ones are now on the market, made according to well developed rules, and, once fitted, always fit, and without the least danger of sticking because of expansion and contraction, which pertains to the wood pin. Another point: If the patternmaker must use the wood pin, let him bear in mind that one-fourth inch of uniform diameter (tapering rapidly beyond this, to a point) is amply sufficient on any pattern, and too much on light, small patterns. And, if the molder shall be obliged to eke out your work with a pen knife, you ought to be ashamed of yourself.

The Record of Seth Boyden's Experiments in Malleable Iron, being a relation of his elaborate experimentation in the development of the art, will be published in the December FOUNDRY.

"THE FOUNDRY is a perfect gem. I find it invaluable and wish it long life and prosperity. Yours faithfully,

"JAMES GALT,
"Paisley, Scotland."

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Trade Outlook.

The general feeling of confidence and satisfaction with regard to industrial conditions that has prevailed for months past is well sustained. There are, of course, some adverse expressions, as may be at all times and under all general conditions expected. However strongly the current of business prosperity may run, here and there a barque will be crowded aside, into the eddies, or will b run down by a larger ship, and the signals of distress will of course appear. There are at all times numerous concerns just staggering on the ledge of bankruptcy, and any commotion, benign or otherwise, is apt to topple them over. The fact is that demand for manufactures has grown so large as to cause a little advance in price of raw material which cannot as yet be compensated for by an advance in price of finished product; and the firm that was barely living before, necessarily runs at a loss under the new conditions, or gives up the contest. That manufacturers generally are making a profit there is no question, for, otherwise, new building would not be so large a factor as it now is in the industrial situation.

The fact that American producers are to some considerable extent marketing both raw and finished cast iron products in Europe, at a time when the home demand is larger than ever before, indicates conditions that ought to be highly gratifying to people generally on both sides of the water. The steadiness of prices of raw materials in face of the great and constantly growing demand is remarkable. It indicates a conservative disposition on the part of producers, and a better general knowledge of industrial and commercial conditions than has marked the past.

A considerable advance in price of pig iron might be quite possible in our home market if conditions abroad were the same as here. We cannot advance the price for export and still hold the foreign trade, which latter must be retained in order to balance the supply and demand. The great expansion of all lines of industry is fast reducing the surplus supply of labor, and the tendency of wages will therefore be upward. At the same time, the increased domestic consumption is rapidly curtailing the necessity for export; indeed, some furnaces are said to have ceased booking orders for the remainder of the year. In view of the general situation it is not at all impossible that the United States will be able ere long to consume the whole product at a price considerably in advance of present quotations. The stocks of iron at the furnaces in most districts are being rapidly reduced, and if this continue at the present rate till January 1, there will be nothing left. However, there are said to be a considerable number of idle furnaces that will start up so soon as any material improvement in price takes place. This will tend to prevent anything like a boom in prices, and at the same time, it assures a sufficient supply for legitimate purposes. While a small advance in price might be a good thing for all concerned, otherwise the situation is very satisfactory.

Why Don't You Tell It?

Perhaps you can't write poetry; maybe if you were to attempt to write a history of the world it might not turn out quite satisfactory in all respects; possibly the higher mathematics is beyond you—just a little; and, here and there is a man who doesn't spell just the same as some other people, but, ten to one, he knows more about mold-

ing in half an hour than lots of them do in a week!

Why not tell it? Tell it to us, and we'll tell it to some thousands of people where it will do the most good. It's easy as rolling off a log. Just sit down and write it out and send it along. Don't tell us you can't write—we used to be something of a liar ourselves! Had we not cured ourselves of that pernicious habit, after having been convicted by writing a technical article in response to the kindly solicitation of an editorial gent, who called us "another" when we said we couldn't, we never should have been driving a six-hundred-dollar span of bangtails to a five-hundred-dollar carriage—indeed, there are many nice little things we might have missed if we had not quit saying "I can't." Just write us anything you want to, in your own way, and we will see that it goes. You know, Horace Greeley couldn't write so that you or I could read it, but he had a printer in the office who took the manuscript and straightened it out so that the public could understand what the old man meant.

You have good ideas—that's your business; the public wants the benefit of them—that's the public's business; we run an editorial mill to shape the good ideas up in—that's our business—see? Now, just send in your ideas and watch THE FOUNDRY for results, and see if we haven't stated it about right..

The "Hustler."

Tecumseh Swift, writing in the American Machinist on "Bargains in Labor," says: "I never knew an establishment in most successful swing that was run by a hustler."

What is a hustler? His name indicates his qualities pretty accurately, and almost exhaustively. He hurries, and he makes everybody else hurry. He has a rubber neck, and looks behind to see if the boss is coming, and in all other directions to see if everybody is working as fast as he can. He does not know whether everybody is doing his work as it ought to be done or not. He is not a good mechanic; if he were, he would not be a hustler. He does not turn out so profitable a year's work as a level-headed, good mechanic would, because his mechanical ignorance, combined with his hustling proclivities, render that impossible. But he makes a great deal more of noise, attracts much more attention, is the moving, hustling spirit of the whole outfit, and on the surface, seems to be accomplishing great things. He is a bullying, browbeating fellow, and the workmen fear him. They do not fear him as one who may do them physical violence, but as one who, they well know, will not listen to advice; who will not discuss mechanical operations civilly and dispassionately. Many of them know him to be their inferior as a mechanic, and as a man. He accords them no respect, and they reciprocate his want of courtesy, and despise him as a matter of course. He therefore fails utterly to win their good will and consequent hearty co-operation. In the very nature of the case, he is entirely dependent, for his position, upon his hustling powers, and he fears his employers more than his subordinates fear him. It cannot be otherwise than that, under his management, many mistakes are made; if by himself, he hides them if possible, otherwise, he ascribes them to a subordinate; if by a capable foreman of a department whose abilities render him a possible rival for the superintendency, he hurries away to the proprietor and shows it up in all its glaring hideousness, while, ten to one, his having unremittingly "hustled" the foreman was the real cause of the fault.

We have in mind a certain large manufacturing concern that employs a typical hustler as superintendent. He is not a mechanic, of any kind; makes no claim to being such, his principal qualifications being those of the "hustler." The condition of the business is sufficiently indicated by the fact that the whole plant is very badly run down, and the interest charge is barely supportable.

The typical hustler is never found at the head of first-class and highly-prosperous concerns. Where he reigns these conditions are impossible.

The man who thoroughly understands his business, having good common sense, and system well developed; who is reasonably approachable in his attitude toward the workmen, and who moves quietly along, directing affairs with as little friction and noise as possible, will accomplish a greater volume and a vastly superior quality of work at a given cost than would be possible to the hustler, to say nothing of the benefits arising from the fact that the customers are satisfied with the goods, and the cost of selling is correspondingly reduced. We particularly wish not to be misunderstood in our use of the term "hustle." We fully appreciate the value of energy, promptitude and

speed in factory operations; but, unless these forces be intelligently guided, they are apt to prove elements of cost rather than of profit, and we believe that the hustler is the very poorest of helmsmen.

"Looking Backward."

There are walls of brick, of stone and marble all around me; high buildings that shut out the heaven, and below are hard pavements, and iron tracks where trolley cars rush along; light wagons and huge vans crowd the street, and many pedestrians hurry to and fro. What a busy world it is! No time for looking backward? Well, yes, sometimes one may, and with profit, halt for a little while—just a few moments, and, throwing off every thought and care for the maddening turmoil of the present, give rein to memory, and so, revisit the pleasant scenes of long ago!

The mind, somehow, submerges in oblivion the unpleasant features of the by-gone days, while we recall with gladness the "good old times," and revel in the recollection.

It is not always so, 'tis true; but the inexorable conditions of the present are from without, and affect us whether we will or no; but the past is all our own, to do with as we will.

There is a past in every life that will bring happy moments to the present if we will permit it.

A breath of air, burdened with the scent of May-weed, or of clover blossoms, will sometimes carry one back to the little old farm house, where locust trees lined the roadway, and yellow-throated meadow larks sang from their perches on the rail fence; and where you and Tom Howe, who lived in the red-painted house, half a mile further up the road, in the pleasant grove of poplar trees, traced, with your bare feet, plans of houses and barns in the dust of the road, or, straddling hoe handles, galloped away down the lane to the bars of the cow pasture. Later, you went to the city, and learned the molders' trade. The buoyancy and glamour of life were still with you. How you did work! and how you enjoyed it! What an exquisite thing was life! And what splendid things the future had for you! There was no doubt—hope was equal to realization.

It was a jolly time, indeed—working, singing, joking, wrestling, and may be a fight, once in a great while—but no knives or pistols then—just a manly fisticuff set-to; and good nature following it.

The crane—do you remember the crane?—the rope (big enough to lift a saw mill) wound two or three times round the drum, and Pat Sheedy pulling at the unattached end, to keep it from slipping while "Big Mike" wound her up. And the cupola?—wasn't it a dandy! May be some of you gray-haired boys have forgotten; let me remind you. It had a solid bottom, with a large "breast" at the tapping place, which after each heat, was torn away, and the cinders were raked out through it, answering, as it did, instead of the drop-bottoms of to-day. Then, the cupola was not a wrought iron shell such as we now use; but it was made much like a flour barrel, the great staves being of cast iron and the hoops of wrought iron. On top of the staves was set a cast iron plate as a foundation for the brick stack which was built up through the roof, and formed the upper portion. The staves would sometimes get out of position, and the blast would come tearing through; but a handful (or a bucketful) of mud would stop it. And the fan, wind-box, and pipes and tuyeres would make a modern chemico-test-bar - Colliau-positive-pressure founder laugh to look upon it. The outlines of the fan were much like those of the present time. The sides were made of pine boards, the periphery of a sheet of tin, nailed on. The fan blades were of sheet iron, the arbor of steel, running in common cast, babbited boxes, set in a wood frame. The main blast-pipe was simply a long wooden box leading from the fan to the back of the cupola; thence sheet-iron pipes led around to within a few feet of the tuyeres. One end of a leather sleeve was tied fast round the end of this pipe, while the other end was similarly made fast to the tapering pipe that entered the tuyere; which latter was, perhaps, a cast iron thimble skein box. But, our fathers melted iron all right with these crude facilities—sometimes! Of course, the string that held the pipe in the tuyere would sometimes get burnt off and the pipe would fly out and twist about on its leather joint, up and down, this way and that way, round and round, blowing off hats and filling eyes and molds with dust, till somebody should make a lucky dive and catch it!

Those were the days when men on light work had to be given "privilege iron." They stood by and watched the iron till it got to running hot enough for their work, and then, —stand aside, everybody! the light work must be poured now or never—a hot streak is coming and it's going to turn red and dull again before long; pour your teakettles and spiders now, we'll cast the "chunks" later on!

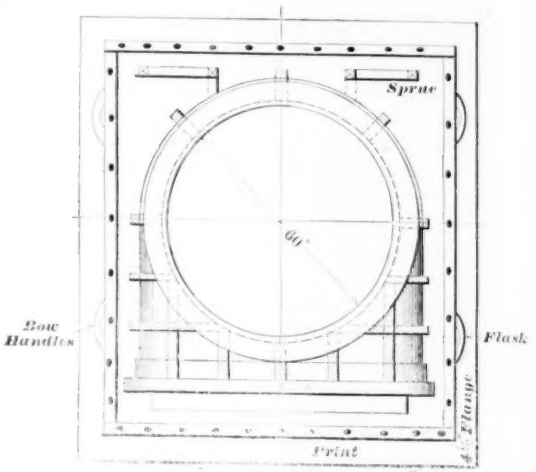
And so it went; and, weren't we as happy then as now? We learned lessons from our losses then, as now; we improved things a little here and a little there, even as we are doing now. But, there was something different then; the boss knew every man in the shop, from Andy Thompson, the "head molder," to Micky Gibbons, the core boy. Didn't the boss' wife sit up nights with Mickey when he had the diphtheria?—indeed she did. And, indeed, there were a good many pleasant features of the old days that it is pleasant to think upon now and then.

A Large Hydraulic Valve.

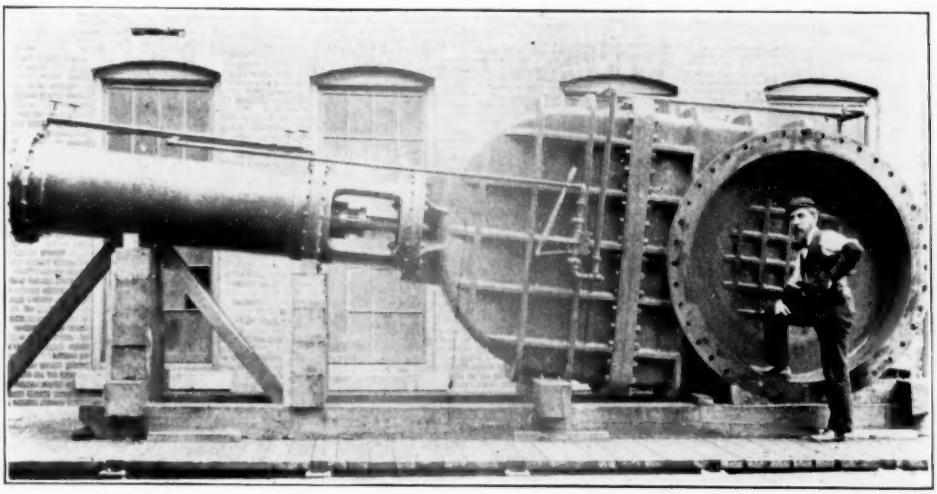
By ARCH. LOUDON.

This valve was made in the foundry of the Michigan Brass and Iron Works, Detroit, Mich., for Ft. Ann, N. Y. The body, top discs and extension piece were made in dry sand; the cylinder, in loam. The complete valve weighed 28,000 pounds, including 2,000 pounds of bronze, used in lining the cylinder. The total length was 24 feet.

The method of molding the body of the valve may be new to some of the valve foundries. The main, or body part, was cast in one piece, in the position shown in sketch, in a two-part flask (cope and drag). The pattern was made in one piece, the flanges being made in removeable sections, to facilitate withdrawing from the mold.



The core was made in three pieces, the two round ends being separate from the internal, principal part. In setting the cores, the round part for the bottom end was first placed in position, and upon this the body part of the core was set; then, on top of all, another round section, which completed the core. The bottom section of the core was provided with a conical projection which fitted nicely into a corresponding depression in the main section, and the top section was similarly guided to place. The core was, of course, hollow, having a 3-foot hole in it,



into which the molder went, and filled securely with loam all joints; then the whole inside was filled with fine coke.

It was cast with two ladles; one of the pouring basins having two down-gates leading into the bottom round flange. The branch gates at the joint of the mold are indicated by x-marks, the dotted lines at right angles thereto showing their direction into the flange below. The three pop-gates from the other ladle were set on top of the elliptical flange, their position being shown by the three x-marks. The risers, (o in sketch) were six in number.

The top section of the valve was made with the side shown in the illustration up, the joint of the mold being at the bottom of the rounded corner; thus nearly the entire mold was in the drag. The core was held in position by two chaplets at the bottom and three on top, held in position by a binder across the flask, and in addition by a hook-bolt from the top of arbor, passed down through the mold and the bottom-plate and held by a nut, and the casting showed not a variation of a sixteenth of an inch in the position of the core.

The cheek of the cylinder mold was built up in two parts, for convenience in finishing; the core, in one part, with a plate on top, and bolted down through the bottom plate. The cylinder was 7 feet 4 inches long, the core being 20 inches diameter. It was poured through pop gates on the top end. The whole outfit was completed without the loss of a single piece, at a cost of fully fifty per cent less for labor than would attend the making of a 60-inch valve as ordinarily molded.

Philadelphia Foundrymen's Association.

The regular monthly meeting of the Foundrymen's Association was held at the Manufacturers' Club, in Philadelphia, on Wednesday, October 5, the president, P. D. Wanner, occupying the chair.

The Executive Committee reported that they had purchased an electric lantern, and the same had been set up for use that evening.

Nomination of officers for the ensuing year was the first business taken up, and on motion of Mr. Devlin all the present officers were nominated for re-election, as follows:

President, P. D. Wanner, of Reading Foundry Company, Limited, Reading, Pa.

Vice-president, A. C. Pessano, of George V. Cresson Company, Philadelphia.

Treasurer, Josiah Thompson, of J. Thompson & Co., Philadelphia.

Secretary, Howard Evans, J. W. Paxson Company, Philadelphia.

Executive Committee: Walter Wood, chairman, R. D. Wood & Co., Philadelphia; Thos. Glover, Glover Brothers, Frankford, Philadelphia; E. E. Brown, E. E. Brown & Co., Philadelphia; Stanley G. Flagg, Jr., Stanley G. Flagg & Co., Philadelphia; Wm. F. Sauter, G. Rebmann & Co., Philadelphia. Ex-officio: P. D. Wanner, president; Howard Evans, secretary.

John Birkinbine, president of the Franklin Institute, then, in an address, drew the attention of the meeting to the work done by the Committee on Science and Arts of that institute. He said: Before that committee are brought all the inventions of apparatus or process used in all industries. The committee consider the meritorious points of an invention, and upon their verdict the institute confer certain medals or awards to the inventor. I felt it might be to the mutual interests of the Foundrymen's Association and the Franklin Institute that the institute, under the patronage of this association, should each year provide for the awarding of a medal or medals for the production of the most meritorious castings, or the greatest progress made in the foundry industry during the year. How the arrangement may be consummated I do not at present know, but I thought I would make the suggestion to you, and if it met your approval a committee could be appointed to take the matter up. If you think the idea would benefit the association or be productive of good for the foundry trade I know the Committee on Science and Arts would be willing to give their time to help the thing along.

Howard Evans: Supposing several castings were presented, how would it be decided as to which was most meritorious?

Mr. Birkinbine: The decision would be made by your association and the committee. A sub-committee would be appointed to pass upon them, and to be sure that no one interested in the castings would thus be able to pass upon them, the rules of the institute provide that no one who is a member of the committee may be interested in anything coming before it. The awards are

made, as far as possible, strictly on merit. We go ourselves to the parties having inventions and request that they bring them before the committee—do not wait for them to come to us. Our medals are quite numerous. One was provided by John Scott, who bequeathed a sum of money to the city of Philadelphia for the purpose, and the city turned the fund over to the Franklin Institute. Now, supposing you, as an organization, should undertake the collection of specimens of work, and you found a marked development made by some improvement in process, say in the manufacture of malleable iron, you would then bring the matter before the Franklin Institute, with a request that they consider it with a view of giving an award. The award could be either a medal you provide or a medal with which you were associated. The details must be worked out to suit the two organizations.

The idea appearing to meet the approval of the meeting, a motion was made referring the matter to the Executive Committee, to be reported upon at the next meeting.

Geo. C. Davis, chemist to Thos. Devlin & Co., Philadelphia, then read a paper on "The History of Malleable Cast Iron in America." At the conclusion of the reading a vote of thanks was passed to Mr. Davis for the paper.

The following letter was handed in and read, as bearing upon the paper:

"Philadelphia, March 28, 1898.

"To Mr. Chas. McKeever:

"Yours of the 27th inst. at hand, and concerning your questions would say I was employed with Stellwagon & Bryant from 1833 to 1837, at the foundry, Germantown and Susquehanna avenues, in the manufacture of malleable iron castings. The firm hired two men, T. Miller and E. Sarin, from Newark, N. J., to teach about eight or twelve green hands, of which number I was one, the trade of molding and casting. I believe they knew nothing of the process of annealing, because neither those two men nor any of us were allowed to go into the annealing house. Mr. Bryant considered that a secret that very few men knew anything about, and he was all the time trying experiments, and was generally successful. After being in business about five years the business closed up, so I believe it was carried on at Newark, N. J., before our firm started, as I frequently heard the two men referred to talk about the matter. I am now in my ninetieth year.

"Yours respectfully,

"JOHN DESSALET."

Mr. Devlin: While the subject is under discussion, there is a gentleman here from Newark from whom many points were secured regarding the early history, and whose father, I believe, was one of the chief men with Seth Boyden. I allude to W. G. Morris.

Mr. Morris: Mr. Davis has gone over the ground so very thoroughly that there is nothing for me to say. Regarding the early molding Mr. Dessalet speaks of, I have been all through it. The only shoveling furnace which, to my mind, is successful is one we have now in operation; others I have heard of did not amount to much. We have used ours for the last 50 years. I have worked 48 years in the malleable iron business, and am still engaged in it. I commenced with four buckles on a plate and now I use 60 to 70. I was acquainted with Mr. Boyden, and my father worked with him. I do not think Seth Boyden ever got any benefit from the wrought iron he put up. I think after melting there would not be much of it left; it would all go up the stack. That has been my experience.

Mr. Flagg: What success did you have in melting old malleable iron?

Mr. Morris: In 1865 I went to Chicago to work. There a concern undertook to make malleable iron from Scotch pig, which I think cannot be done. While there, in using annealing furnaces it was customary to use iron bottoms instead of brick bottoms as now used. I undertook to make some bottoms and used old malleable iron and Scotch pig to run it off with. I weighed the castings after the run and found my loss 25 to 30 per cent. I attributed the loss to the malleable iron. Old malleable iron generally burns and makes bad, porous castings.

Mr. Flagg: What was the largest heat that you ran in those days?

Mr. Morris: About 1,000 pounds. I believe 12 tons is sometimes run at this day.

Mr. Devlin: The writing of this paper was, as stated, my suggestion. The people who knew anything of the early history of the business were all passing away, and I, with Mr. Davis and Mr. Morris, visited Newark and secured quite a good deal of matter, too much, really, to need in one even-

ing. Our sole object was to get as much information as possible and I thought it wise not to delay the matter, as there are people living now who can correct inaccuracies in statements, while later they will have passed away.

The discussion was closed by Mr. Birkinbine, who said that the paper impressed three facts upon his mind. First, that the memories of blast furnaces active at those times had passed away. Then, he said, furnaces made about as much in a year as modern furnaces were turning out in a day. Second, that in latter days monuments seemed only to be erected to honor those who have been engaged in killing their fellow men. He meant no disparagement of our generals; but something should be done to keep the memories of other classes of men before us. It was well sometimes to look back and see how our memories of notable men had faded. The third fact was that three-quarters of a century ago men were squirting secret chemicals into furnaces, and the same thing was being done to-day—men claiming to have processes of conversion which would produce results in ten hours. They found, however, they must have a temperature which fitted, for if there were slow cooling bad results ensued. The process was more apt to occupy ten hours and three days.

The meeting then adjourned.

Before all the members had left the building those remaining were shocked to receive news that Mr. Morris had fallen dead on the street on his way to his hotel.

Malleable Cast Iron.*

Its Early History in the United States.

By GEORGE C. DAVIS

Little has been written of the history of malleable cast iron, and so far as I am aware no account has ever been published of the beginning of this industry in the United States. This is my excuse for presenting to you this evening an account of what I believe to be the first malleable iron foundry in this country. The word malleable is often used (especially by English writers) to distinguish soft iron such as is produced by the puddling process and which is usually classed in this country under the general term wrought iron. By malleable cast iron or malleable iron, as it is commonly called, is here meant a casting made from pig low in silicon, sulphur and phosphorus and from which the carbon has been partially removed by annealing in ferric oxide or other porous or infusible substances, the carbon which remains in the iron being present mainly as graphitic temper carbon. I will endeavor to describe the works practice at that time, the difficulties encountered and will briefly mention some of the earlier foundries.

The first malleable iron castings of domestic manufacture were produced in Newark, N. J., in the year 1826. Seth Boyden, to whom belongs the honor of doing this, was a native of Foxboro, Mass., but settled in Newark in 1815, when in his twenty-seventh year. As a boy he worked at farming and occasionally at a furnace operated by one of his uncles. He attended school for only a few short terms, but this by no means ended his education, for he continued his studies by himself, especially in the natural sciences which would aid him in his labors. He showed to a very marked degree the traits of the stock from which he sprang. Mechanical ingenuity and skill with tools came to him naturally. He was, during the course of his long life, occupied with many of the arts and sciences, and so great were the benefits conferred by his many inventions and improvements of existing processes that the citizens of Newark have erected a statue in his honor. Much of the apparatus with which his experiments were conducted was made by his own hands. He made among other things a telescope, microscope, electrical apparatus, and engraved a label for his books. Such work as this was usually done at odd intervals or after the regular work of the day was over and was to him rather recreation than serious business, but it served to show his versatility. Many claims have been made for him as being the inventor of various processes. His original inventions were numerous, but his best and certainly, from a commercial standpoint the most important work was done in perfecting the ideas of others. There are few inventions which are not in dispute, and it is often the case that after learned men have written articles proving to their satisfaction their own side of the case the archaeologists step in and state that the Chinese or ancient

*A paper read before the Philadelphia Foundrymen's Association.

Egyptians knew all about the article in question several thousand years B. C.

Boyden is credited with inventing a machine for making wrought iron nails, a machine for making brads and files, a machine for cutting and heading tacks, and a machine for splitting leather. He also made the first patent or glazed leather, as it was then called, produced in this country, and carried on quite a business in this article for some years in supplying harness makers. He built locomotives and made many improvements in their design. In this connection it is interesting to note that he built a locomotive called the "Cometa" for the Cardenas railway of Cuba, and went there himself in 1841 to put the engine in operation. One of his most important inventions was a machine for forming hat bodies, which he patented. In later years, when old age had incapacitated him from active business, he turned his attention to raising new and improved varieties of strawberries, and succeeded in this as in other things. It was characteristic of the man that a problem once thoroughly mastered he turned his attention to some new process. He seemed to care only for mechanical success, any profits he might derive from his labor being merely useful to enable him to experiment in some other line. It seems incredible that he should have accomplished so much, but his life during the three score years in which he was actively engaged is a good illustration of the endurance and persistence of the hardy New England stock. He took little care to protect his own interests and died a poor man in the year 1870.

Soon after Boyden settled in Newark he was engaged in the silver plating business, and it is possible that this was indirectly the cause of turning his attention to malleable iron. A large part of his business was in plating carriage and harness hardware. In those days such articles were necessarily quite expensive, as they were made by hand from wrought iron. It is evident from Boyden's notes that he had learned that such articles could be cast and rendered malleable by annealing, but he evidently knew nothing of the details of the process. General Runyon, in his address at the dedication of Boyden's monument, said: "What is called malleable iron was known before Mr. Boyden discovered it, but he invented it as truly as ever a man invented anything wholly new and previously unknown." This view has been held by many, but I believe it to be clearly in error, for in experiment No. 6 of Boyden's notes he says "a piece of English M iron was in, but no important alteration." Again under the date of August 4, 1826, we find entry "50 pounds sprue, 50 pounds pig, white, when baked a perfect resemblance of some English of the same size"—thus proving that at about the time Boyden began his experiments he had in his possession some malleable castings that had been made in England.

Let us turn for a moment to note the progress of this industry in other countries. Reaumur had published the fundamental principles of the process in the year 1722, and some years later patents were granted in England for softening castings by annealing in ashes. This process applied to such castings as nails, anchors, cannons, chains, forge hammers, etc. In 1804 Sam Lucas, of Sheffield, took out a patent on malleable iron, but he believed the difficulties to be insuperable and so made no use of his patent in a commercial way at least. His brother, Thos. Lucas, shortly after took up the matter and succeeded in producing cast cutlery, which, according to Parks (essay on edge tools, 1815), would take as fine a polish as the best cast steel. These articles were sold under the name of run steel. According to Percy and other authorities the use of malleable castings rapidly extended, and by 1830 the industry had attained large proportions. The castings were used for cutlery, pulley blocks, carriage and harness hardware and a variety of other purposes. Thus we see that malleable iron had been manufactured in England for some years before Boyden began his experiments.

In 1828 the Franklin Institute of this city offered a silver medal for the best specimen of annealed cast iron to consist of not less than one dozen pieces. The report of the committee of that society says: "Premium No. 4 for the best specimen of annealed cast iron is awarded to Seth Boyden, of Newark, N. J., for specimen No. 163, being an assortment of buckles, bits and other castings remarkable for their smoothness and malleability. This is the first attempt in this country to anneal cast iron for general purposes that has come under the knowledge of your committee, and the success attending it fully entitles the maker to a silver medal." From the wording of this report it is evident

that the committee were aware of the manufacture of malleable castings abroad, and in awarding the medal to Boyden it was merely for excellence of workmanship on a novel article. There is no hint in the wording of the report of the process being regarded as an invention of Boyden's prior or otherwise.

His experiments with malleable iron of which we have record extended over a period of six years. At first they were carried out in his house, the iron melted in a crucible in a forge fire and the castings annealed in a small furnace, using hard coal, erected in his fire place. In this way he made a series of 12 experiments to determine the best pig iron to use, the best packing, proper temperature for annealing, etc. A part of experiment 6 is here shown which illustrates a series of diagrams used in some manner to keep track of the various mixtures of iron:

One-seventh wrought, six-sevenths Sterling; fine, strong, superior, good before anything I have ever seen.

One-fourteenth W., six-fourteenths Sterling, near the same as above.

One-twenty-eighth W., six pieces S., near the same as above; a little darker.

Sprues of above near the same as above, the above bent to less than ½-inch circles.

He was evidently sufficiently encouraged by the results obtained to erect a foundry, which was started in the summer of 1826, for on July 4 of that year is the first entry under the heading "Experiment in Foundry." His observations and deductions were exceedingly shrewd, though his explanations were often at fault. When we consider how little was then known of chemistry and metallurgy this is not surprising. The selection of a suitable pig iron occasioned him little difficulty, though he tried many brands separately, and in various mixtures. He mentions Peru, Carthage, Bennington, Vt., three brands of Salisbury—viz., R. B. & Co., H. C. & Co., and C. S. Co.—two brands of Egg Harbor—viz. Etna and Weymouth—Sheldon, Washington, Amenia and Scotch. This latter was soon given up, the notes experiments 10 and 11 stating that it was brittle. The reasons for this we can well imagine. Few of the brands here mentioned are familiar to the foundrymen of to-day. Etna and Weymouth recall to us the industries which once existed in the Jersey pines. Of these once flourishing concerns scarcely a trace remains. Weymouth furnace was located on Great Egg Harbor river, about six miles from May's Landing. It was erected in 1802 and has long since been abandoned. Etna furnace was situated on a tributary of the south branch of Rancocas Creek, 2½ miles from Medford, and 4 miles from Taunton in Burlington County (Swank's "History of Iron in All Ages"). The Salisbury furnaces are probably the only ones now on the active list. The companies referred to—viz.: Richardson, Barnum & Co., Canfield, Sterling & Co., and Holley & Coffing, all operated plants in Litchfield County, Conn. The works owned by the last named firm were located at Chapinville, and here was built the first blast furnace in Connecticut. This was about 1762, at which date Ethan Allen was one of the owners of the property. Holley & Coffing also operated a furnace at Mt. Riga, which was most probably the one from which Boyden obtained his iron. This furnace began operation about 1810 and was abandoned in 1856. Amenia furnace was located in Dutchess County, N. Y., 24 miles east of Poughkeepsie ,and not in Connecticut, as Boyden states in his notes. This furnace began operations about 1770. Iron from the Salisbury district was hauled by teams to Hudson or Poughkeepsie and thence transported by water. So far as can be learned iron was not sold on commission, at least in the early days. The dealings were direct between producer and consumer, and payments were made in cash or more frequently on long time notes. The Sterling Iron Works were located in Orange County, N. Y. This iron was considered for many years one of the best brands for malleable castings and was in use for the purpose as late as 1861. The Long mine, from which Boyden obtains some of the ore for packing, was located on this property. Peru and Carthage furnaces are supposed to have been located near the towns of the same names in New York State.

Boyden tried various additions to the molten iron, such as sulphur, phosphorus, tin, zinc, lead, antimony and nickel, but soon

gave them up, as the effects were either injurious or negative. In the last entry, September 1, 1832, there is a brief reference to melting on a basic lined furnace, which reads, "the more iron if free from carbon the stronger heat is required to anneal it; lime on bottom in place of sand iron equally good." Boyden evidently believed that pig iron melted in an air furnace lost most of its carbon. When the silicon had fallen so low that the castings came white, the carbon being in a combined state, he evidently thought the carbon had been removed.

In annealing, serious difficulties confronted him. He succeeded in producing well annealed castings, remarking October 20, 1826, "I have a piece so good it will not harden any more than copper, and when hammered is scarcely inferior to the best wrought iron." He soon determined the proper temperature for annealing, as at a number of places in his notes he writes of keeping the pots at the temperature to melt silver—954 degrees C. At intervals during the night when it was necessary to add fuel he used a primitive alarm to awaken him. This was done by placing a candle on a nail so that when the candle was burnt down to the nail the rest would fall on a piece of metal and thus awaken the sleeper. His notes bear records of many failures, and we can scarcely realize the work entailed by the numerous experiments, especially with various types of pots and methods of packing. The small furnaces in which the experimental work in annealing was done must have required frequent attention. Concerning this part of the process he seemed to be to a great extent groping in the dark. For packing he tried various kinds of native iron ore, Spanish brown hematite, maganese ore, sand, clay, lime, ashes, hammer scale and various mixtures of them. At first large amounts of saltpeter were used, but this caused soft scale and he soon learned to use less. Other substances, such as alum, salammoniac, pearlash and plaster of paris, were used, as he says, "to strengthen the packing." Thus on May 1, 1827, we find the entry "packed in oxide of iron, one-thirty-second saltpeter, one-thirty-second alum, and one-eighth lime added; casting covered with a thick scale, though it was perfectly air tight." It acted like sulphur or plaster of paris, which shows that a packing composed of two different materials will destroy the iron when either of them would answer well alone. Boyden also tried other experiments in packing, such as sand and alkali white, which were failures. He writes under the date of April 3, 1827, "the conclusion is that red oxide of iron is important and in fact the best thing known for packing, and Sterling, well refined the best iron." Of the other difficulties he encountered the two worst were "black porous" and "crystallizing." As to the causes of these we can only surmise. Boyden himself soon learned to remedy the former trouble by remelting with a small amount of wrought iron, thus lowering the silicon and preventing the formation of graphitic carbon, which may have been the cause of the trouble. He attributed crystallizing to silex (silica), and said April 3, 1827, "by a number of experiments and observations it is evident that crystallizing proceeds from silex in some way. Pig iron made from ore containing much silex or silex getting into the iron when melting or annealing, the iron will be brittle and porous."

The crystallizing may have been caused by insufficient time and temperature in annealing or by high sulphur in the casting, resulting from remelting and large additions of sprue, thus rendering annealing difficult. The iron annealing pots wore out so fast that he tried various ways to prevent it, such as brick pots coated with lead and clay and lined with sheet iron; earthen pots surrounding the iron ones; iron pots packed in ore and small iron pots inside larger ones. The reference, November 22, 1828, to the established size of the main pots evidently refers to these outer pots. In some cases reannealing remedied his troubles, as owing to this practice of using earthen pots which are poor conductors of heat, the inside of the charge probably was not hot enough at the first trial. One interesting experiment from a chemical point of view is given under the date of April 21, 1831, where the author says "one pot filled with work, but no packing, the steam of alcohol conveyed in during the heat; work was not quite as good as the other way, covered with soft black scale. A piece of casting annealed as above was rather brittle and crystallized; was again heated two hours in hydrogen gas and was changed to tough piece free from crystals and in every sense good." These experiments were evidently of no practical value, but it would be interesting to know how they

were made with the crude apparatus at his disposal. So much for the technical view of the industry.

Passing now to the consideration of the commercial features and works practice, during the first few years we find that the foundry which Boyden erected was located at 28 Orange street in the rear of his home on Bridge street. It gave employment to about 60 molders. At first and for much of the experimental work the iron was melted in a crucible, using charcoal or hard coal for heating. Lime was the flux most frequently used, but experiments were also made with other substances, such as iron ore, sand, clay, glass and sulphur, with this end in view, evidently with the idea of leaving nothing untried. Some of these were obviously forlorn hopes, as in experiment No. 9 we find the entry, "Delaware, one-eighth W., pounded fine with glass, brittle as usual." Boyden's practice seems to have been to run the iron very "high," for he speaks in a number of places of the iron being "sparkling" and "smoky," the latter term presumably indicating incipient oxidation and a very high temperature. Considering these facts it is somewhat remarkable that no mention is made of shrinkage, which does not seem to have troubled the early founders at all. An air furnace was soon built with a capacity of about 1,000 pounds. The fuel was dry pine wood or soft coal, and it is said that eight heats a day were made, starting at 3 a. m. and often not finishing until late in the evening. This furnace was not tapped; the iron being dipped out in clay washed ladles holding from 10 to 12 pounds each. In the notes, June 12, 1828, there is a reference to Virginia coal. This coal probably came from the mines in Chesterfield County, near Richmond. Nichols, in his book, "The Story of American Coals," says: "In 1750 the Virginia bituminous mines were opened and worked on the James river near Richmond; these mines were the first to be opened for the market in the United States. Owned by an English company and competing only with English coal, they enjoyed for some time the exclusive coastwise trade of the Union. In their nature the coals are very dry and gaseous." These mines are not now worked, but were in operation as late as 1842. So called patent fuel (coal and rosin) came into use March 25, 1831. Rosin at this time was very cheap, seventy-five cents to $1 a barrel, and so continued up to the Civil War, when it rose rapidly in price, reaching at one time, it is said, $68 a barrel, and coal tar was used instead.

The first cupola was built in 1832, and used hard coal. This cupola was of the solid bottom type, and consisted of a straight shaft, the upper part of which could be lifted off so as to allow cleaning and repairs after a heat. The pig and fuel were charged in the top or at a door near the top. Surrounding the shaft was a large bell shaped draft stack. An archway through this stack afforded entrance to the charging platform, there being ample room between shaft and stack for the men to work. Such a cupola as this could be operated only every other day, as the cinders and unmelted stock required time to cool so that it could be dug out and repairs made to lining. The use of cupolas and air furnaces for melting malleable iron was up to a comparatively recent date peculiar to this country, it still being the practice in many foreign works to use crucibles.

Molding sand was obtained from a place between Newark and Elizabeth. For cores, sand from Rockaway, L. I., was used, the binding material being wheat or rye flour. The patterns were usually made from white metal, though iron, brass or wooden patterns were sometimes used. Fewer pieces were molded on the gate than is now the practice, as it was thought impossible to run them. For 1-inch buckles from four to eight were placed on one gate, though several gates were molded in one flask. The flasks were made of sheet iron, circular in shape, and were fastened together with a button and eyelet hole. The castings were cleaned in a tumbler, which was made from a keg strengthened with iron hoops. A door was cut in the side, and holes bored to let out the sand. Iron journals were bolted on the ends. The journal boxes were of wood, and power was furnished by a belt over the center of the keg.

The first annealing furnace was shaped like a bee-hive, and the pots were inserted from the top, which could be removed by a crane. Mill scale was packed around the pots, and the whole kept at an annealing heat for a week. This type was succeeded by a rectangular furnace which was run continuously. The floor was laid on an incline, and the

charging done from the higher end. The whole charge was moved along, and pots were thus pushed out at the lower end, hence the name "shoving furnace." This furnace was closed by large bungs, luted at the joints and held 48 pots which were about 12x10 inches. They had a solid bottom, and after packing were covered with an overlapping tile inverted and the joints luted. The fire boxes were on the side, with inlet ports near the top of the furnace, thence the flame went to the upper end and then down to the flues that led underneath to a stack near the lower end. Pine wood, charcoal or soft coal was used for fuel. The castings were cleaned by tumbling with leather and stars. A considerable variety of castings were made, comprising, as the catalogue—a small card size 3x4 inches printed on one side, stated, over 1,000 different articles. Among the articles enumerated are "Cavasons for the Spanish market." Judging from this Boyden was as fuly alive to the advantages of a foreign trade as are some of our modern imperialists. It may be necessary to explain that a cavason was a ring with a staple cast on it which is put on the nose of a horse in order to wrench it so as to facilitate breaking in. The demand for castings was mainly local, and at first they met with the usual opposition. The blacksmiths objected to the variable character of the metal and feared it would do away with much of their trade. The prices obtained at first were about 25 cents per pound, but they gradually fell to 8 cents by 1854, and afterward rose somewhat during the war.

EARLY FOUNDRIES.

In the early 30's Otis Boyden, a brother of Seth's, had started the Crockett Foundry in Newark. This was burned down in 1835, in which year the Boston M. C. I. & S. Co. bought out what was left of the Crockett foundry equipment and also Seth Boyden's establishment, where they continued in business until 1837, when they failed. Thus Seth Boyden's connection with the malleable iron business ended in 1835 after continuing nine years, though, as we shall see later, several of his brothers started other foundries. The Boston Company were succeeded by a stock company, who from time to time underwent various changes in membership, until at the present day the place is operated by W. G. Morris, under the firm name of Morris & Barlow. Part of the original building still stands, serving as the wall of the present foundry, though it has been raised several feet.

The extension of the malleable iron industry was very rapid, and several foundries were started in various places at about the same time. Many of the concerns were short lived, as they suffered from the financial troubles of 1837 and the difficulties encountered by any new process. It is impossible in the time at my disposal to do more than briefly refer to some of the others. There were two concerns in Elizabethport of which I have been unable to learn very much, except that they were probably started previous to 1840. David Meeker began making malleable iron in Hedenburgs Works in Newark in the year 1841, but removed two years later to his present location, where the business is now conducted by S. J. Meeker. The New Jersey Malleable Iron Works were started in 1848 on the spot where the Market Street Station of the Pennsylvania railroad now stands. At one time there was said to be eight malleable iron foundries in Newark.

In Massachusetts the malleable iron business was first established in East Boston about 1835 by a company incorporated with a capital of $100,000, and under the management of Alex. Boyden, a brother of Seth's. A younger brother, Frank, was also employed there. This concern only ran about two years, as there was not much demand at that time for machinery castings of malleable iron. The company made stock goods, such as hammers, axes, chisels, etc., very little light cored work being attempted. They evidently followed along the lines of the earlier English works, as large quantities of castings were made under the impression that they were steel, which could not be sold, and as no dividends were forthcoming the stock was bought up by a few persons, who crowded out the Boydens. So far as can be learned the practice in these works differed in no essential from that already described. "Flat Bar" Salisbury pig was used, and the melting was done in two air furnaces, capacity 1,000 and 1,600 pounds, respectively, the latter being considered a large furnace at the time. A cupola was erected, but for some reason did not succeed. It is said that the packing was oxidized with sea water.

In 1837 Alex. Boyden was employed by Frederick Fuller, of Easton, Mass., who at

that time was operating the Easton Iron Foundry (established in 1752), to start a malleable iron foundry in Easton, certain land and buildings being leased to Boyden for $350 per year. This paper begins according to old legal form: "This indenture made the first day of March, 1837, by and between Fredk. Fuller, of Easton, in the County of Bristol, gentleman on the one part, and Alex. Boyden, of Easton, in the County of Bristol, iron founder on the other part, witnesseth," etc. Evidently in those days the distinction between an iron founder and a gentleman was sharply drawn. The foundry was continued under Boyden's management about a year, when his interest was bought out by Lincoln Drake, who was the executor of the Leach Estate, owners of the Easton Foundry, and who had been Fuller's financial backer. Boyden agreed not to establish or help establish any other malleable iron foundry in New England. In 1838 Danl. Belcher took charge, buying out the business ten years later and continuing it until his death, which occurred in 1890. At these works about one-quarter "flat bar" Salisbury and three-quarters Sterling iron was used, which was valued in the inventory, taken 1840, at $50 per ton. Flat bar was the common name for Salisbury iron at that time, but from which of the furnaces it came or whether it was common to all of them I have been unable to learn.

I am indebted to Geo. C. Belcher, the present proprietor of these works, for many of the interesting details of the early practice, and feel that I cannot do better than give the account in his own words. He says: "The molders made their own cores, dumped and trimmed their own castings, and helped the melter when skimming the slag from the air furnace, for all of which they received $1.25 per day. The fuel used in the air furnace was Pictou coal, costing $14 per chaldron—36 bushels—and pine limb (trash wood). The charge was 800 pounds, sometimes 1,000, and the writer well remembers when the melter, without consulting the 'boss,' had the temerity to put in 1,500 pounds. With what anxiety all watched the furnace for something to happen, expecting the bridge to give way and let the iron back onto the grates, or that the whole business would puddle and refuse to run when tapped. The bottom of the air furnace was made up of quartz mixed with a little clay and stood about 16 heats. The quartz was obtained in the neighborhood, and was first calcined in the air furnace and was then pounded up. Stourbridge fire brick were in common use at this time in the construction of the furnaces. The annealing furnaces were also run with Pictou coal and pine wood, the firemen firing up every 15 minutes. The annealing pots were pushed in on rolls at one end of the furnace, and pushed out when done at the other end by the introduction of fresh pots. Very soon after he took charge Mr. Belcher built a hard coal annealing furnace, which while building was ridiculed by all old hands, including the melter, who was from Newark, but proving successful, was afterward claimed by the melter as his own invention. The castings made at first were carriage, harness and stove trimmings, fliers for cotton speeders and fly frames, pump castings, mule fingers, loom forks, keys, axle nuts and shanks for garden trowels. Pipe fittings were manufactured here as early as 1849 and possibly earlier. They were shipped to Walworth & Nason, of New York City, to have the threads cut. The price obtained for axle nuts in 1840 was 12½ cents per pound; stove trimmings, 15 cents per pound. Average price of castings, including cored work, 16 2-3 cents per pound, or one shilling. Large speeder fliers, however, brought 50 cents per pound. In looking over the old patterns some years ago I found that many of them were finished and gated in a superior manner. Match plates, similar to those now used in machine molding, were employed with good success and molds were made rapidly. The flasks were made of cherry wood, and the workmanship on them was of the best. I am indebted to Horace Spaulding, of Easton, for much of my information. Mr. Spaulding, who is now 83 years of age, was a molder in the East Boston foundry, and is the only person now living who was concerned with the Malleable Iron Works when first started. He relates that in the early days of the business Alex. Boyden used to have a little pump or syringe with which he used to squirt something into the air furnace stack, and also used to drop some kind of metal, probably zinc, into the molten iron, creating a smoke, all of which was to make a mystery of the process in the minds of the workmen."

One of the first malleable iron foundries in the Central West was established in Cincinnati, Ohio, previous to 1850, and possibly as early as 1845, by Miles Greenwood and

Thomas R. Wood, under the firm name of M. Greenwood & Co. So far as can be learned the works practice was similar to that already described. Missouri surface ore pig was considered essential, and commanded an extra price on that account. The iron was melted in a cupola, and later an air furnace was erected.

In closing the writer wishes to acknowledge his indebtedness to O. S. Boyden and W. G. Morris, of Newark, N. J.; Milton H. Robbins, of Lakeville, Conn.; Geo. C. Belcher and Horace Spaulding, of Easton, Mass.; James L. Haven, of Cincinnati, Ohio, and Thomas Devlin, of Philadelphia, Pa., at whose suggestion this paper was undertaken.

Modern Cupola Practice.*

By BERTRAND S. SUMMERS, Chicago, Ill.

The question is sometimes asked, What is the most important element governing the quality of cast iron for any particular purpose? It would seen that right here lies the basis for the greatest difference of opinion. Some 20 years or more ago silicon was regarded by foundrymen as one of their worst enemies; but since the work of Turner and of Keep, silicon has been greatly growing in favor, until one might say that it is regarded in some quarters as the panacea for all evils encountered in the iron foundry. This has led to the founding of a school, the followers of which seem to regard silicon as an all important element, and it would appear, indeed, that in some quarters it is regarded as the one element of decisive importance in pig iron. It is the writer's opinion that graphite is the controlling element in pig iron, and that a greater success is obtained where this metalloid is governed than in cases where the silicon only is watched. We are more or less familiar with the well-known ideas that by gauging silicon the exact mixture suitable for any purpose is obtained; it being only necessary to keep the carbon above a certain unknown minimum, and the silicon being determined crudely by shrinkage and other methods. Indeed, we not infrequently encounter specifications in which the silicon is specified, but no mention is made of either graphitic or total carbon.

SILICON.

This, as nearly every one will agree, is a very important element in foundry practice, its most prominent function being that of promoting the formation of graphitic carbon, while it also lowers the saturation point of iron for carbon. The former is the property that concerns the foundryman almost exclusively; and it is necessary for him to know about how much silicon cast iron should carry, in order to have the desired properties. Excluding other effects, which will be taken up later, we must always consider what kind of castings are to be made in order to know what content of silicon to strive for in the casting. It seems fair to say that nothing absolute can be stated regarding this question. Frequently we notice in text books and journals that if iron carries this or that percentage of silicon it will have certain properties. This sweeping general proposition the writer cannot accept, being of the opinion that other conditions will affect the content of graphitic carbon as much as, if not more than, the content of silicon. In general, if it is desired to make good machinery castings of close structure, and at the same time so soft that no difficulty will be experienced in tooling them, the silicon should be between 1.50 and 2 per cent., or may even run to 2.25 per cent. It is always wise in these cases to consider the iron used in the mixture. It is well enough to say in a general way that if we have the same chemical composition in cast iron we will have the same properties, but experience has shown that this is true in a general way only. For example, mixtures in which the chief component is charcoal iron, show a perceptible difference from those made entirely from coke iron. The reason for this seems to lie in the different conditions of the carbon, which will be mentioned later.

For light hardware, in which great strength is not a very important item, it is well to run the silicon up even as high as 3 per cent. This practice has several advantages. It tends to make the iron more fluid, so that it will take delicate molds well, and avoid difficulty or loss due to shrinkage. It is also said to enable the foundryman to carry more scrap in his mixture. This assertion, however, is open to serious doubt, as the amount of scrap which a mixture will carry is dependent upon the carbon content of the mixture and the scrap.

As silicon approaches or exceeds 3 per cent. the casting becomes more and more brittle, and it is desirable to keep well within the limit of 3 per cent in most classes of

*Read at the Buffalo meeting of the American Institute of Mining Engineers.

foundry work. For most foundry purposes, on the other hand, a silicon content below 1.5 per cent is to be avoided.

As stated above, these rules as to silicon are only true for ordinary foundry mixtures. Special metals, and mixtures containing peculiar irons, are often found to contradict some of the above statements. The figures given, however, are an excellent guide for general practice, and will be found applicable in most cases. It will be developed later that there are other influences which affect the iron more than does the content of silicon.

SULPHUR.

The good effects of silicon are often counteracted by the presence of sulphur, and mysterious troubles encountered in the foundry are not infrequently traceable to this element; the practical foundryman being, in this respect, usually at the mercy of the pig iron manufacturer. Most brands of soft iron, both charcoal and coke, are usually considerably below the danger limit in sulphur. Foundrymen, however, are frequently misled by the statement that sulphur need not be considered, as it never occurs in pig iron in sufficient quantities to affect the results of their work. If analyses are made of drillings from castings that give trouble to foundrymen not possessing means for determining sulphur, the trouble will, in many cases, be traceable to this element. In most instances, sulphur is introduced into the mixture through the ferro-silicon irons used to supply the silicon to the charge. The writer has found well-known brands of ferro-silicon containing 0.17 and 0.18 per cent. of sulphur, and in one case 0.34 per cent. If a careful watch is not made of these irons, or if strict specifications are not drawn upon them, it is not infrequent that 0.10 per cent. of sulphur is found. Most furnacemen endeavoring to do so can keep the sulphur below the limit of 0.05 per cent. Not long ago the writer was consulted in regard to some faulty castings, and analysis of them showed 0.12 per cent. of sulphur. The iron was full of small cracks radiating in all directions; but they were not perceptible on the surface, and could only be discovered when the castings were struck with a hammer. When this was done the casting would fall into many pieces, and the fracture would plainly show that the casting had been previously cracked from one-fourth to one-half of its depth, the remainder of the shell being severed by the blow. Furthermore, the casting showed signs which might have been taken as indicating cold shortness. In all probability the sulphur had been introduced in this case through the ferro-silicon, as the casting carried a considerable content of silicon. A maximum limit of sulphur for good foundry practice should be fixed at 0.10 per cent.; but foundrymen should strive to keep it below 0.08 per cent.

PHOSPHORUS.

This element is present to a greater degree than is commonly supposed in most cast irons. It may be said that for the greater part of foundry work it is an excellent ingredient up to a certain limit. This limit, for most cases, is about 1 per cent. Where great strength and resiliency are desired the phosphorus should be very much below this point. However, in cases of this kind it will seldom be noticeable in high graphitic iron, where it is kept below 0.5 per cent. In snap flask work phosphorus is a very desirable element to the foundrymen, tending to make the metal fluid and to keep it so. Its effect on strength is not immediately discernible if the test bar of cast iron is subjected to a transverse stress. In most cases, if the stress be applied gradually, a high phosphorus iron will register nearly as high as one of lower content. A severe blow upon the bar, however, will soon make apparent the difference in the irons. It is weakness under sudden shock that phosphorus most distinctly promotes; and for this reason it should be kept low where this property would be a detriment. Like sulphur, phosphorus occurs in large quantities in the ferro-silicon irons commonly used in foundry mixtures. It may be stated that most of the common brands of these compounds on the market carry 1 per cent. or more of phosphorus. The writer has known cases in which 7 per cent. silicon iron carried more than 1.60 per cent. of phosphorus. Of course, this is unknown to most foundrymen not having facilities for analyzing their iron; and in this way phosphorus is frequently introduced into mixtures which never should carry a high percentage of it.

It may be interesting to note here the case of a special semisteel, mixed by the writer, which carried a trifle more than 0.8 per cent. of phosphorus, graphitic carbon being 1.84 per cent., total carbon 1.97 per cent., and

sulphur normal. The bar broke under transverse stress at 3,940 pounds. Another one made from the same mixture broke at 3,910 pounds. The writer has frequently found bars made of this metal which carried over 1 per cent. of phosphorus and broke above 3,000 pounds. In the case of the 3,000-pound bar the resiliency was considerable, the bar possessing spring and showing a considerable deflection before breaking. It would seem from this that phosphorus is not nearly as much to be feared as is commonly supposed.

MANGANESE.

Very little has been said of manganese in its relation to general foundry practice. It is, however, an important element in many ways. It will scarcely be noticed in a mixture up to 0.8 per cent., as far as the ordinary foundryman is concerned. Frequently an excellent casting is found to contain over 1 per cent of manganese. It is not very long since it was suggested that manganese is a very beneficial element in cast iron, and it has been asserted by some metallurgists that a considerable content of this element is desirable. The writer's experience with manganese in general practice has not been extensive, but it seems to him that this modern view is to be looked upon with favor. Although it is well known that manganese promotes combined carbon, silicon predominating in the iron would tend to counteract this effect. Manganese, however, has considerable effect on the magnetic properties of the iron, which has been discussed in another paper by the author (Journal of the Society of Chemical Industry, December, 1897.)

It is well known that manganese possesses the property of preventing sponginess of the metal, or blow holes, by reacting with the occluded gases of the metal; and it seems that the modern view is going to work considerable advance in this way. If the foundryman should be able to run sufficient manganese into his mixture, without hardening the metal, to rid the iron of blow holes or prevent sponginess, manganese will soon be in high favor for general foundry practice. There is reason to believe that this will come to pass at no very distant date. Since the publication of the above mentioned article of the writer, later studies of the effect of manganese upon the magnetic properties of iron have adduced striking arguments, tending to substantiate the ideas advanced by R. A. Hadfield, as to the probable existence of a carbide of manganese, which exerts considerable influence on the properties of steel. It would seem, however, that in high carbon irons, particularly in those carrying a considerable proportion of graphite, this effect is somewhat hidden. It is more noticeable as the content of graphitic carbon decreases.

CARBON.

The consensus of opinion seems to be that a great deal is yet to be discovered relative to carbon. Anomalies have frequently been encountered in foundry practice which seemed to indicate strongly that a clearer knowledge of the state of the carbon would greatly aid matters. There is no question that graphitic carbon is the softening agent in cast iron; and, so far as silicon can control this it is the governing agent. The writer hopes to show, however, that in many cases silicon is powerless to effect this change in the state of the carbon. It is doubtful whether the form of carbon usually called graphite is always composed of the same variety of carbon. It will be remembered that some five or six years ago, Professor Ledebur, in an excellent paper on carbon in iron, described four states of this metalloid. The carbon in a transition state toward graphite (as we may describe it) he termed graphitic temper carbon. He also stated that there was no known method of determining this form, and that it was always estimated with the graphite. It is open to question then if, in many cases where we determine graphite, some of it does not represent graphitic temper carbon.

To digress a trifle, mention might here be made of an old dispute between the practical man and the technologist as to the value of the fracture in determining the quality of pig iron. Probably most technologists will agree that, as a general indication, this practical method is very useful, but very misleading. Some time ago the writer had an excellent opportunity to observe this. A very open grained iron was found to contain much less graphite than an iron possessing a fracture of inferior appearance.

S. H. Chauvenet has given some interesting figures, showing that a lower bed fed from the blast furnace is normally always close grained, though it gives practically the same analysis as the rest of the cast; and he shows, further, how obstructions in the tap hole which cause intermediate beds to fill up

slowly will make those beds close grained, while if the lower bed be filled rapidly it will show an open grain. Finally, if we compare a charcoal iron with a coke iron, it is a well-known fact that although the charcoal iron may carry a very much higher percentage of graphitic carbon, it shows a closer and denser fracture, while the coke iron has a very open fracture, the graphite occurring in nests, as it were, and falling to the ground in flakes when the iron is handled. A possible explanation of this might be that the graphite commonly determined in charcoal iron represents relatively larger proportions of graphitic temper carbon, while the coke iron carries a very much smaller percentage. The iron, assimilating the graphitic temper carbon, makes a close and homogeneous metal, while the graphite tends to open the grain and segregate, thus frequently causing sponginess in the metal. This would seem to explain the reason why charcoal iron makes a denser and more uniform metal when introduced into foundry mixtures, and hence is generally preferable to coke irons. This suggestion is offered tentatively; the writer not being able, as yet, to identify the temper carbon in such irons.

It may not be amiss, in this connection, to cite an incident in the use of the semisteel mentioned above. This metal possesses a magnetic permeability midway between cast iron and cast steel, being a gain of about 50 per cent. over cast iron. A test bar from a machine, which had showed inferior results, proved the metal to have the same permeability as cast iron. This being unexplained, an analysis was made of the bar, with surprising results. The analysis was almost identical with that of a bar which had showed superior results in this direction. The graphitic and total carbon were practically identical. The mixtures were entirely the same, and the metals had been worked in the foundry in the same way, with the exception that different blast pressure had been used. The bar showing the lower results was very open and showed a dark grained fracture. The bar giving higher results presented a characteristic silvery appearance and was soft and tough. It was exceedingly dense and turned more like steel, while the former bar turned just as cast iron would do. The micro-photographs of these two bars showed radical differences, and seemed to confirm the view that these were due to temper carbon. Further, this metal, when properly made, is homogeneous throughout the casting, and the graphitic carbon shows no tendency to segregate. It would seem from this that the state of the carbon was the governing factor; and cases such as this have prompted the above suggestion.

In this laboratory an attempt was made to oxidize the temper carbon by prolonged treatment with fuming nitric acid under high temperature, but without avail. This is in accord with previous work along this line. Hopes are entertained that investigations now in progress will yield some method by which temper carbon may be identified and estimated in these irons.

COMBINED CARBON.

It is usually admitted that combined carbon embraces more than one kind of carbon. This is, to some extent, substantiated by work upon the magnetic permeability of metals relatively high in carbon. However, the present state of the art will not permit much to be said with certainty in this direction. Reference may be made in this connection to recent work of Messrs. Donath and Haissig on silicon irons, in which they cite the fact that a high silicon iron, when analyzed for carbon by ordinary methods, gives about 1.36 per cent. less of carbon than when the drillings are oxidized completely by combustion with lead chromate, or volatilization in chlorine. Lower results were also obtained when the metal was oxidized with chromic and sulphuric acid. This difference, Messrs. Donath and Haissig suggest, is due to some silico-carbide. The writer has endeavored to duplicate these results, working on a ferro-silicon containing about 7.5 per cent. of silicon. The total carbon, obtained by solution in a double chloride and the residue burned in a combustion furnace, was 2.24 per cent. In every case in which the carbon was determined either by direct combustion with lead chromate, or the residue from the chlorine treatment burned in a combustion furnace, the results agreed quite closely with those obtained by solution in a double chloride. It is possible, however, that the results obtained by these scientists may be true for ferro-silicon higher in silicon; or it may be that the metal used for their experiments was in some respect anomalous.

RELATION OF SILICON TO GRAPHITE.

Having discussed these general relations, let us now endeavor to see what grounds

there are for the assumption that silicon is the governing factor in cast iron. If we have several pieces of cast iron, made at different dates from practically the same mixture, the analyses of which show practically the same total carbon and a variation in silicon, we have an excellent opportunity to trace the effect of silicon. For example, in the following table are irons which would seem to show this quite clearly:

Table I.—Analyses of Charcoal Iron Castings.

	I.	II.	III.	IV.
Silicon	2.20	2.66	2.92	2.41
Graphitic carbon	2.92	2.93	2.77	2.98
Total carbon	3.44	3.48	3.41	3.42

The other constituents of these irons are nearly the same, and all of them are controlled as far as possible in foundry practice. They were made from almost identical mixtures, as is clearly indicated by the uniformity of total carbon. It is evident that this table does not support the unqualified assertion that an increase in silicon causes a proportional increase in graphite, and the practical rule, based on that theory, that silicon may be blindly added to the foundry mixture, without considering other conditions, in order to increase graphite and soften the iron, is not substantiated. Comparing irons I and III, we find that although the latter contains 0.72 per cent. more of silicon than the former, the graphite is 0.15 per cent. lower, while the total carbon is practically the same. Obviously this increase in silicon has not produced graphite, yet the total carbon indicates that there was no marked difference in burden.

Taking IV. as the second in the series, we see that silicon increases by about 0.20 per cent., yet that the graphite is nearly constant, except as to III, which is both highest in silicon and lowest in graphite. The fair deduction seems to be, either that silicon has no marked effect upon graphite in ordinary foundry practice, or that there are other conditions more potent. The latter view seems the more probable.

The above analyses are taken from a vast number made in the course of practice, which confirm this conclusion. Daily records for months show conclusively that the silicon varying between 2 and 3 per cent. has not nearly the effect on the graphite that it is usually supposed to produce. No relation apparently exists between the change of silicon and the content of graphite within these limits, and there is little if any doubt, if we can judge from this long series of tests, that there are other influences in cupola practice which are more potent than the variation in silicon. The above table has been selected as most clearly setting forth this view.

Another proof of this proposition is seen in the analysis of pig iron, before they are introduced into the cupola. Pig iron shows the effects of the metalloids in the blast furnace, instead of in the cupola; yet even in the blast furnace, with its high temperature, the silicon is not always able to govern the graphite. For example, the following are strong indications in this direction:

Table II.—Analyses of Pig Irons.

	I.	II.	III.	IV.
Silicon	7.94	7.43	3.36	3.30
Sulphur	0.041	0.029	0.051	....
Phosphorus	1.39	1.05	0.606	....
Graphitic carbon	2.02	1.95	3.31	3.26
Total carbon	2.24	2.19	3.33	3.37

Here it appears that the irons carrying more than 7 per cent. of silicon have less graphite in proportion to the total carbon than the one containing 3.36 per cent. Number III, however, is a remarkable iron, and one that is seldom seen, although its high proportion of graphite to total carbon is quite characteristic of the brand, and has been found in most shipments received from this furnace. This anomaly must therefore be due to local conditions.

The castings in Table I were all compounded from high graphitic charcoal iron. In coke iron mixtures the failure of silicon to increase the percentage of graphite is even more marked. The following analyses are taken from casts made entirely from coke irons:

Table III.—Analyses of Coke Iron Castings.

	I.	II.	III.	IV.	V.	VI.	VII.	VIII.
Silicon	2.85	3.76	2.62	2.47	3.18	3.11	2.79	2.95
Sulphur	0.073	0.083	0.074	....	....	....	....	....
Phosphorus	0.557	0.612	0.469	....	....	....	....	....
Manganese	0.39	0.260	0.42	....	....	....	....	....
Graphitic carbon	3.13	3.05	3.17	2.55	2.69	2.78	2.67	2.61
Combined carbon	0.18	0.24	0.08	0.74	0.51	0.62	0.54	0.50
Total carbon	3.31	3.29	3.25	3.29	3.20	3.29	3.21	3.21

The first four members of this table have about the same total carbon, and were made from the same irons, with but minor changes in the burdening. It is readily discernible from these irons that little if any relation-

ship can be traced between the silicon and the graphitic carbon. Looking at the last four members, the total carbon contents are seen to be practically identical, while the graphitic carbon is very nearly the same in the irons containing the highest and the lowest content of silicon; and, again, no relation can be traced between silicon and graphitic carbon. As in the case of the first four, these mixtures were compounded from the same irons with but minor changes in the burdening.

That temperature controls the effect of silicon is shown when a close examination is made of different shipments of the same brand of pig iron, the blast furnace running on the same ore mixture. A case came under my personal observation recently, in which the graphitic carbon ran from 3.40 to 3.50 per cent., the silicon remaining in the neighborhood of 1.5 per cent.; but when the silicon rose to 1.8 or 2 per cent. the graphitic carbon rose above 3.50 per cent. In nearly every case of this kind a decrease in the total carbon was likewise noticed. This has also been frequently noticed with other brands of iron, and it is more apparent with charcoal irons than with coke. The heat in the blast furnace seems to be great enough to make the silicon a more important factor.

It is hardly legitimate to attribute these differences to the effect of the other elements, as a glance at the tables will show that they do not vary enough to enter into the consideration. It would seem, on careful consideration, that the effect of silicon is largely governed by the temperature at which it is allowed to act. It is doubtful if the necessary temperature is obtained in the cupola to permit the silicon to have a very strong effect upon the corbon, where its content does not vary beyond certain limits. It also seems probable that, where the burden is light, the effect is not as marked as in the case of large burdens, where more heat is developed.

INFLUENCE OF COKE RATIO.

Frequently one hears among foundrymen that this or that one uses certain fuel ratios, but it is seldom stated under what conditions the melt is made. One foundryman is melting iron with a ratio of one to 13, while his neighbor is running on a ratio of one to seven. This means almost nothing, unless the amount of iron melted and the condition of the material introduced into the cupola are taken into consideration. It need scarcely be said that the foundryman who melts 60 tons per day can make a better showing in relation to fuel consumption than one who melts 5 tons and has the same iron poured from his cupola. The foundryman having a smaller burden uses more coke on his bed in proportion to the iron melted. It is also evident that, where it is desired to melt large pigs and large sized scrap, a greater coke consumption is necessary, to tap the same iron from the cupola. Barring these two conditions, which are evident to every one, the iron is, within certain limits, softer when more coke is used. If analysis is made of metals cast with different coke consumption and practically the same burden as a general rule, the one melted with the higher coke consumption, up to a certain limit, will contain the most graphite. This is only true when the cupola is run on a coke consumption below what is really necessary to pour iron of a high temperature, and this, again, is largely dependent upon the blast; but where little attention is devoted to the blast, and especially where the blast pressure is below what it really should be, an increased coke burden will often have a beneficial effect upon irons, if too much is not added. If a foundryman is using his blast judiciously and the coke ratio is figured for the best economy, little can be gained from an increased coke consumption.

(To be Continued.)

CAST IRON NOTES.

Devoted to Inquiries from Practical Foundrymen on the subject of Melting and using Cast Iron. Address all Inquiries to W. J. KEEP, care of The Foundry.

MODERN CUPOLA PRACTICE.

I have been requested to state whether Mr. Summers, in a paper on the above subject, presented at the October meeting of A. I. M. E., did not disagree with my own expressed opinions. With regard to the practicability of controlling the quality of foundry castings by chemical analysis, we are in perfect accord. He says: "It is well enough in a general way to say that if we have the same chemical composition in cast iron we will have the same physical properties, but experience has shown that this is true in a general way only." "Of two test bars from mixtures entirely the same, treated in the same way, except with a different blast pressure in the cupola, the chemical

analysis was almost identical, but the physical qualities were entirely different."

The paper is written in support of a mistaken opinion of Mr. Summers that increasing silicon in a mixture does not change combined carbon into graphite or soften iron, and that the amount of silicon contained by a pig iron does not indicate its capacity for carrying scrap; that silicon is not the element by which the quality of a casting can be controlled, but that the graphitic carbon and the total carbon control the quality of the casting. He states all this many times, but he does not prove his statements. He gives the analysis of some dozen irons, one-half of which indicate that he is wrong, and in the paper he admits that his premise is incorrect. Here are a few quotations: "Silicon promotes the formation of graphite. It is necessary for the founder to know about how much silicon cast iron should carry, in order to have the desired properties.

"We must know what kind of castings are to be made in order to know what content of silicon to strive for in the casting, but nothing absolute can be stated regarding this question.

"Silicon tends to make the iron more fluid, and avoids loss due to shrinkage."

"There is no question that graphitic carbon is the softening agent in cast iron, and so far as silicon can control this, it is the governing agent."

"Carbon is undoubtedly the governing factor in irons. Silicon can do nothing without a certain carbon content, and total carbon is one of the most important elements to specify in the purchase of foundry irons." He says that his foundry specifies 3.75 per cent. total carbon, and silicon anything, so long as necessary carbon is furnished. But he says that a minimum graphite specification is inserted in nearly every case. He says he pays very little attention to silicon, as most of the high carbon irons will carry sufficient silicon for most classes of work, but that it is often useful to require a certain silicon content in the iron so as to get sufficient graphite, as the heat of the blast furnace is sufficient to enable the silicon to control the graphite to a great extent.

"Temperature of the blast furnace controls the effect of silicon. A pig iron with silicon 1.5 per cent. contained 3.40 to 3.50 per cent. of graphite; with silicon 1.8 or 2.00, graphite rose above 3.50 per cent. The effect of silicon is largely governed by the temperature at which it is allowed to act." He doubts the theory that silicon may be blindly added to the foundry mixture without considering other conditions, in order to increase graphite and soften the iron. He thinks the desire for silicon has been carried to an extreme. He says that the plan of gauging the value of irons by their content of silicon is but one step in advance of judging by fracture.

He says that some have said that silicon is the cure for all evils, but he thinks that graphite is the controlling element, and that greater success is attained when graphite is governed than when silicon only is watched.

He says: "Even if we admit that an increase of silicon can cause an increase of graphite, yet if there is not sufficient carbon present to be changed into graphite, the graphitic carbon cannot be obtained in the required proportion." He says sulphur often counteracts the good effects of silicon; that phosphorus is not nearly as much to be feared as is commonly supposed; that manganese prevents blowholes, and promotes combined carbon, but silicon tends to counteract this effect.

There can be no disagreement with all of the above quotations, but Mr. Summers seems to wish to disagree with some one, and says that he proves that silicon has no influence in promoting graphite. He acknowledges that it is difficult to have the furnace people furnish analyses of total and of graphitic carbon, and discourses at length about four kinds of carbon; but as this is guess-work it is not important to the founder.

He states that in his opinion high silicon irons are useless, and that as ferrosilicons invariably contain less carbon than pig iron, the addition to a low carbon mixture further decreases the carbon, and on this account does not permit the use of more scrap.

While the addition of high silicon irons does reduce carbon and therefore silvery irons with lower silicon are better, yet it is the universal experience that an increase of silicon enables more scrap to be used.

Mr. Summers, in his effort to disparage the use of silvery irons as softeners, says that they contain excessive sulphur, as high as 0.17, and in one case 0.34 per cent. With the exception of silvery iron, made exclusively from mill cinder, he cannot find an ex-

cess of sulphur in silvery irons, but he allows in castings a maximum of 0.10 per cent., and he would not use enough of any silvery iron to introduce such a percentage.

Now, where is the difference in a specification of a certain amount of graphite, or a certain amount of silicon?

The foundation principle is that silicon can only soften iron by changing carbon to graphite, and the more total carbon the more carbon there is to change.

It seems unnecessary to write a paper in support of the contention that the graphite controls the character of the casting.

No doubt it does, but silicon is the chief cause of graphite being formed. The founder has no practical way of increasing graphite, except by increasing silicon.

A horse is controlled by the bit, but the driver by controlling the bit controls the horse. Mr. Summers, as well as everyone else who has had experience with melting iron, has found that a given percentage of silicon cannot in every case be depended upon to produce a given physical composition, because the varying carbon content, and the varying conditions attending the melting, often exert a greater influence than the silicon. And yet it does no harm, and it is correct to say, barring unforseen conditions, that an increase of silicon will produce a corresponding change in physical quality.

It is known that I try to make this matter so simple that the ordinary founder can understand it, and for this reason I prefer to measure the shrinkage, which is a measure of the influence of silicon under all the prevailing conditions.

If the shrinkage is high, the silicon must be increased, and if lower than ordinary, the scrap can be increased. Measuring the physical quality and then correcting it by altering silicon is within the reach of the understanding of every founder.

Most founders will never be able to understand anything more, and fortunately for money-making, nothing else is needed, except a physical test for strength.

Deaths.

Horace Wiley Soper, of the American Foundry & Furnace Co., Chicago, is dead at the age of 56 years.

Timothy McHugh, the Chicago founder, died there October 16. He came from England while young, and learned his trade in Cincinnati.

Samuel Lewis, malleable iron founder, of Pittsburg, died October 10. He founded and operated the Lewis Malleable Iron Works, and had been in business for 50 years.

Enoch Page died at Scranton, Pa., aged 62 years. At the time of his death, September 23, he was superintendent of foundry of the D., L. & W. shops, Scranton, Pa., where he had been employed for more than 30 years.

William Shaffer died at Reading, Pa., September 29, 61 years old. He was born in Sanatoga, Pa., but spent most of his life in Reading. He was in the machine shop of the Johnston Foundry Company twenty years, most of the time as foreman. He was after that a member of the firm of Davis, Printz & Co. for twenty-two years.

Louis De Blois Bartlett, formerly president of the Putnam Machine Company, Fitchburg, Mass., died at Marblehead, Mass., October 19, 73 years old. He was born in Marblehead and served his time with Otis Tufts in Boston, went to Fitchburg in 1859 and lived there the rest of his life. He became connected with the Putnam Company, and was successively director, treasurer and president, retiring from business in 1885.

Benjamin Fox, who has conducted his foundry for a period of fifty years in New York City, died after a very brief illness. He is said to have been one of the old-style proprietors, who got acquainted with his employes, and kept acquainted, interesting himself in their personal welfare, and, so endearing himself to all. Such men can be hardly spared, and his death is a calamity to many.

Horace B. Miller, one of the two founders and original sole proprietors of the "American Machinist," died at Napa, Cal., October 25, of heart failure. He was born in Philadelphia in 1839. He served in the navy in Farragut's fleet during the civil war. His connection with the management of the "American Machinist" ended in 1894, and his stock therein was disposed of in 1897. Mr. Miller was an associate member of the American Society of Mechanical Engineers from its beginning, the preliminary meetings of that society having been held in the editorial rooms of the "American Machinist." He was also a member of the Press Club of New York.

Frank F. Hemenway, who was for nearly fourteen years connected with the

editorial department of the "American Machinist," and for several years its editor-in-chief, died in Brooklyn October 14. He was born at Hartford, N. Y., October 29, 1837, and received a good common school education. He served under Gen. N. P. Banks in the civil war. He was a fine mechanic, and occupied the position of superintendent of the machine shop of the old Starbuck Brothers' plant, Troy. While here he invented the Hemenway automatic cut-off engine. He was a charter member of the American Society of Mechanical Engineers. His principal contributions to literature concerned steam and steam engines, his book on the steam engine indicator being still in demand. He is said to have been marvelously correct in his technical knowledge, and his writings were always lucid and uplifting. He was a kind, true friend, and helpful to all. The American Machinist's obituary on him says: "The bitter word that it seems necessary to say, without reproach and without sitting in judgment, is that he was not kind and he was not just to himself. Much more than a fair share of this life's misfortunes fell upon him. He contended bravely against them for years, all the while helping others to bear their far lighter burdens, and he gave up only when further battling was plainly hopeless. He was married while quite young, and the three children born to him are all dead."

William G. Morris, of Newark, N. J., died of heart disease, on the street in Philadelphia, late at night, October 5. He had been in attendance at the meeting of the Foundrymen's Association, and had taken part in the discussion of the topical paper on the "Early History of the Malleable Iron Business." Mr. Morris was about 62 years old. He had been engaged in the manufacture of malleable iron all his life, having begun as an apprentice at molding in his boyhood, advancing through the various gradations until, not many years ago, he became head of the firm of Morris & Barlow, successor to the original firm of Barlow & Condit. He was the son of a foundryman, his father having served his apprenticeship under Seth Boyden, the discoverer and developer of the processes in malleable iron manufacture. Mr. Morris was regarded as one of the highest authorities on the founding of light castings, and by many as the very highest in the art of malleable iron making. He was a member of the Corinthian Council of the Royal Arcanum, Enterprise Lodge of the Knights of Honor, and the Newark Lodge of the A. O. U. W. He leaves a widow, son and daughter. The period of his life of 63 years comprises

WILLIAM G. MORRIS

nearly the whole history of malleable iron manufacture, a branch of metallurgy that has advanced by great leaps and bounds until to-day it is one of the great industries of the manufacturing world; an industry whose history cannot be written without including the name of William G. Morris.

New Buildings and Enlargements.

A new foundry, 100x66 feet, is being built at Sycamore, Ill.

Work is begun on the new Wetherell foundry at Chester, Pa.

The foundry of E. Walker, at Homaton, Ala., recently burned, is being rebuilt.

Pettinos Bros. are erecting a large foundry and chemical plant at Bethlehem, Pa.

The Dunbar Mfg. Co., Northville, Mich., has added a brass foundry to its plant.

John F. Riley, Charleston, S. C., is in the market for equipment of iron and brass foundry.

Wm. Bates is building a new foundry at Portland, Wis., 20x60, two stories high, with a lean-to.

The Graff Stove Company is about to move into its new foundry buildings at Monongahela.

Work is well under way at the new foundry of the American Steel Castings Co., at Chester, Pa.

The Wisconsin Malleable Iron Co., Milwaukee, will erect an addition to warehouse to cost $3,000.

The Tennessee Coal, Iron & Railroad Co. is about to erect a new foundry 240x80 feet at Ensley, Ala.

The Parsons Band Cutter and Self-Feeder Company, of Newton, Ia., is building a new foundry, 70x54 feet.

The Buffalo-Pittsburg Company, Buffalo, N. Y., will operate a foundry in the old Kellogg Iron Works, Buffalo.

At Bellaire, O., Anderson Bros. & Simpson will build a foundry and machine shop on the site of their burned plant.

The Vandling & Wurtzell Foundry, at New Brighton, Pa., has started up and will produce machinery and stove castings.

The Berlin Bridge Co. is building a new foundry for the Benjamin Atha & Illington Co., at Harrisburg, Pa., 51x152 feet.

The Louisville Foundry & Machine Works is the style of a concern just started up at Louisville, Ky., by John O. Doltinger and Geo. Abell.

Cutler & Proctor recently built an addition to their foundry at Peoria, Ill., and have purchased more land in anticipation of further expansion.

The Joseph Dixon Crucible Co. has added a large new building to its plant, and will increase the boiler capacity. The business of this firm is booming.

The Stowell Manufacturing & Foundry Co., of South Milwaukee, will erect a 50x150 feet addition for the manufacture of malleable iron, to cost $6,000.

The foundry building of the Youngstown Foundry & Machine Co., Youngstown, O., is being considerably enlarged and a 20-ton traveling crane installed.

The Co-Operative Stove and Foundry Co., of Wheeling, W. Va., has been chartered. This company uses the abandoned plant of the Fisher Foundry Co., recently retired.

At Gaffney, S. C., T. H. Littlejohn, J. D. Templeton and B. T. Porter have formed a partnership as the Gaffney Machine Co., and will establish machine shop and foundry.

The Titusville Iron Co., Titusville, Pa., is erecting an addition to its radiator plant, 418x80 feet. A saving of iron is effected by the employment of a new machine for molding their radiators.

The Benjamin, Atha & Illingworth Co., of Harrison, N. J., is erecting an extension to their foundry 152 feet long. The framework is of steel and the work is being done by the Berlin Iron Bridge Co.

The Totten & Hogg Iron and Steel Foundry Company, of Pittsburg, will add two 24x32-inch hot mills, one 20x36-inch cold mill and other machinery to the plant of the Johnstown Tinplate Company.

Keck, Gonnerman & Co., Mt. Vernon, Ind., are erecting a brick addition to their new foundry, 40x60 feet. A new 60 h. p. Corliss engine, a new boiler, besides several new machine tools, have also been added to the plant.

The Aschman Steel Casting Co., of Shearon, Pa., is looking for a new location for a steel foundry. It is the expectation to employ from 200 to 250 men. The company desires a location a little nearer Pittsburg than it now has.

The Middleborough Foundry and Machine Company has been organized to operate the Crowe Foundry and Machine Works; will also use the foundry and machine shops of the Holliday Stove Works and will put up a large traveling crane, several new buildings and other improvements at Middlesborough, Ky.

The Missouri Car & Foundry Co., St. Louis, is building a malleable iron foundry at its works at Madison, Wis. The building is about 600 feet long and 175 feet wide. The company has also contracted for an addition to its wheel foundry at Madison. This will be a steel structure 250 feet long and about 175 feet wide.

The Superior Drill Company, Springfield, O., will, this season, build an addition to its main shop, 147 feet, four stories high, with an L the same dimensions, for storage purposes. The foundry will have a 75-foot addition, and new cupola with 15 tons capacity.

This is to accommodate the fast increasing business of the company.

The Ellwood Foundry Company, Ellwood City, Penn., has been organized and has secured ground, 200x160 feet, on which it will erect a plant. The main foundry will be 50x85 feet, one story high. There will be additional buildings for pattern shop, machine shop, sand sheds, core ovens, coke house, etc. The new company will make castings for gas engines, and a general line of machinery castings.

The Utica Belt Line Railroad Company, Utica, N. Y., are erecting on the line of their road a new riveted lattice bridge having a span of about 75 feet. The bridge is known as the Half-way Bridge. It is a modern structure in every way for the class of work which it is called upon to do. It is to be all steel except the cross ties on which the rails rest. The Berlin Iron Bridge Co., East Berlin, Conn., have the contract for furnishing and erecting the steel work.

The Berlin Iron Bridge Co., East Berlin, Conn., are erecting for the Seamless Metal Co., Sing Sing, N. Y., across the railroad tracks connecting the different parts of their plant, a steel foot bridge. The bridge consists of lattice trusses about 68 feet long, supported on steel trestle bents on either end. Underneath the bridge is a substantial trolley beam designed to carry loads from the adjoining building to the switch track of the railroad underneath the bridge.

Among the Foundries.

Eastern stove manufacturers have advanced prices 5 per cent.

Weir, Mass., stove shops are rushed with work as never before.

Irving M. Brown has purchased the foundry of Thos. Stewart at Allegan, Mich.

The new Leechburg foundry at Hays Station, Pa., will be lighted by electricity.

The Burley Heater Co., Tyrone, Pa., made the first cast in its new foundry last week.

The works of the Michigan Malleable Iron Co., at Delray, Detroit, will start up in November.

The brass foundry of the Davis & Furber Co., of North Andover, Mass., has suspended operations.

The foundry of Mallory, Wheeler & Co., New Haven, Ct., has closed down for an indefinite period.

The New York Air-brake Co.'s new foundry at Watertown, N. Y., started up the first part of October.

The Corry Radiator Works at Corry, Pa., have assigned. Execution judgments amount to $21,544.

R. H. Edwards will remove his foundry and machine shop from Wellsboro, Pa., to Lawrenceville, Pa.

E. A. Keene, of Livermore Falls, has leased the Plainfield Foundry for a period of five years from October 1 inst.

F. T. Green has been appointed receiver of the Sioux City Brass Works at Sioux City, Ia. Assets, $8,000; liabilities, $6,000.

The State of Oregon has attached the property of the Penitentiary Stove Foundry Co. for an alleged indebtedness of $52,000.

The employes in the Moline Plow Co.'s foundry struck in sympathy with the striking coremakers, who demand $1.75 per day.

J. R. Cook & Son Co. is incorporated at Americus, Ga. Its plant, foundry and machine shop will be removed from Oglethorpe.

The old Kimball foundry at Lawrence, Kan., will be started up by J. D. Bowersock, under the name of the Lawrence Iron Works.

The coremakers of the National Foundry and Pipe Works, Scottdale, Pa., are out on strike, because the superintendent increased their work.

The Lebanon (Pa.) Boiler, Foundry & Machine Co. made an assignment for benefit of creditors. Liabilities, $22,000; paid-up capital, $50,000.

The Detroit Malleable Iron Co., Detroit, Mich., has filed articles of incorporation. The capital stock is $50,000, of which $43,000 has been paid in.

Business is very dull in the Plankville branch of the Peck, Stowe & Wilcox Co., of Southington, Conn. Many molders have been laid off.

The plant of the National Foundry & Pipe Works, Limited, at Scottdale, Pa., was closed down this week on account of a strike of the coremakers.

The Sanford foundry, which has lain idle for four years, will be started up and operated by David Jenkins, president of the Jenkins Machine Co.

The Stiles Press Manufacturing Co., of Watertown, N. Y., has leased and will oper-

ate the Adirondack machine shop and foundry of Carthage, N. Y.

The molders at the Keystone Foundry, Rock Falls, Ill., win their strike for the rate of wages paid two years ago. All the strikers will be taken back.

The American Pipe and Foundry Co., of Chattanooga, Tenn., with a capital of $500,000, was licensed to do business in Illinois with a capital of $103,000.

The Michigan Brass and Iron Works, Detroit, has the contract to furnish $22,000 worth of valves and hydrants for the new water works, Mobile, Ala.

The Frontier Iron Works, Detroit, Mich., are in the hands of a receiver, because want of sufficient cash capital rendered it impossible to make the business pay.

At the annual meeting of the Kutztown Foundry and Machine Co. the entire board of officers was re-elected. The affairs of the company are in excellent shape.

A foundry will be erected at Ellwood City, Pa., by E. J. O. Davidson and Scott Coates, lately connected with the Derwent Foundry Co. The building will be 40x70 feet.

All the molders, apprentices, coremakers and laborers in the foundry department of the Moline Plow Co. are out on strike in sympathy with the striking coremakers.

The Corry Radiator Company failed, at suit of Jno. Graves et al. Fifty men thrown out of work. It is expected the company will be reorganized. Liabilities, $40,000.

The Superior Drill Co., Springfield, O., is to have an addition 147x41 feet and four stories. An additional 75 feet will be built on the foundry and a new cupola added.

The Troy Malleable Iron Co. have elected the following: President, William A. Grippen; vice-president, Waldo K. Chase; treasurer, Edwin Veght; secretary, Augustus Veght.

While the molders are out on a strike at the foundry of Prospey Pero, Worcester, Mass., Mr. Pero and his son, with 19 apprentices, are in overalls, molding in place of the strikers.

The stove foundry of the Somersworth Machine Company has closed indefinitely owing to the failure of the Sawyer Woolen Co. of Dover. The latter was chief owner of the foundry.

The molders of the Saco & Pettee Co., Biddeford, Me., struck for an advance in wages. The firm agrees to an advance of 25 cents a day, but wants more work, which the molders refuse.

All the molders of the Farrell Foundry and Machine Co., Ansonia, Ct., are out on strike by order of the I. M. U. of N. A., because the company employed a non-union man on a new machine recently introduced.

The recent trouble between the management and the workmen at the Keystone Manufacturing Company's works, at Sterling, Ill., has been settled by the firm's advancing prices to the rate paid two years ago.

At the annual meeting of the Auburn Foundry Co., Auburn, Maine, October 4, the following officers were elected: President, A. M. Penley; secretary, N. I. Jordan; directors, A. M. Penley, N. I. Jordan, B. F. Sturgis, Louis A. Cobb.

An American firm has received an order for an immense number of castings for a large woolen mill and other machinery, to be erected near Pekin, China. This is said to be the first modern woolen mill to be built in the country.

The Search Manufacturing Co., of Sheboygan Falls, will remove to Oshkosh, Wis., and will occupy the old plant of the Star Foundry and Machine Co. They will manufacture horizontal horse-powers, dog-powers, feed mills, feed cutters, etc.

Wm. Todd & Co., of Youngstown, O., have cast successfully the first one of six plates for the foundations of the mammoth blast furnaces now being constructed by the Ohio Steel Co. It is the largest plate ever cast here, its weight being sixty tons.

The Co-operative Stove Co., recently organized at Wheeling, is building a new plant for the manufacture of the Ohio Valley Star stove, first made by the Fisher Foundry Co. The new concern is made up largely of men employed in the old Fisher foundry.

The Southern Hollowware Foundry, owned by colored citizens at Churchville, Tenn., which has been closed down for some months, will resume operations today with a large force of men. The company has enough orders on hand to keep the foundry busy for several months.

The Battle Creek Steam Pump Co., Battle Creek, Mich., has increased its stock from

$100,000 to $200,000, issued and fully paid. The company has doubled the size of its foundry, put in a pneumatic traveling crane, built a new brass furnace, core ovens and added new machine shop equipment.

The molders in 16 foundries of Buffalo, N. Y., have struck for day-work at $2.25 per day. Twelve of the firms have conceded the demands, while four resist. A hard fight is expected by the molders, but they say they are prepared for it. Wages had ranged from $1.25 to $2.25 per day and uniformity is demanded.

In a short time the Harrisburg Foundry and Machine Works, Harrisburg, Pa., will begin work on a big contract for engines and boilers for an immense woolen mill at Tientsin, China, near Pekin, China. Tientsin is a city of 1,000,000 population. The Westinghouse people, of Pittsburg, have the contract for the electrical apparatus.

The Rock Island Plow Company's molders are on a strike, pending an answer to the following: "We, members of Iron Molders' Union, No. 230, hereby demand the same rate of wages and shop conditions existing in the past year for the ensuing year of '98-'99, and expect a satisfactory answer by 6 p. m. October 13, or we will refuse to work longer."

The Louisville (Ky.) Foundry & Machine Co., formerly operated by J. J. Sweeney, has been taken up by Mr. John O. Dolfinger, who recently purchased, reconstructed and equipped with tools the old buildings. This was brought about by the Commercial Club. The works will turn out electric elevators, belted and hand-power elevators, shaftings, pulleys, hangers and gearing.

The Union Iron Works and the Reid Machine Co., of Spokane, Wash., have consolidated. The capacity of the new plant will exceed that of both the old. New buildings will be erected and the capital stock will start at $50,000, to be enlarged as demanded by trade. The officers will be E. J. Roberts, president; Austin Corbin, vice-president; J. M. Fitzpatrick, secretary and treasurer; E. E. Reid, manager; Mr. McCarney, superintendent.

The Berlin Iron Bridge Co., of East Berlin, Conn., are erecting the extension of the foundry for the Benjamin Atha & Illingworth Co., at Harrison, N. J. This extension is 51 feet wide and 152 feet long. The framework is of steel throughout. The sides are covered with corrugated iron on steel purlins, and are arranged for suitable doors and windows. The side columns support a 30-ton electric crane having a span of 46 feet. The roof construction is of steel trusses and purlins arranged with openings in the roof for skylights.

American Foundrymen's Association Bureau for Standardized Samples of Cast Iron.

Committee's Progress Report.

The committee appointed by the American Foundrymen's Association to establish and advance a National Bureau for the distribution of uniform standardized drillings, is now able to distribute a range of samples that it feels will meet the hearty approval and indorsement of managers and chemists employed directly or indirectly in all branches of the iron industry, pertaining to the making or use of pig iron.

The standardized samples now ready for distribution cover the following determinations:

Silicon, one each of a low, medium and high range of cast iron.

Sulphur, one each of a low, medium and high range of cast iron.

Manganese, one each of a low, medium and high range of cast iron.

Phosphorus, one each of a low, medium and high range of cast iron.

Total carbon, one determination.

Graphite, one determination.

Tatanium, three determinations.

In all, 17 determinations made on four (4) samples.

The samples are designated as A, B, C and D. Sample A, which has passed the 40 mesh sieve, gives one total carbon and one graphite. Sample B gives a low silicon, a medium sulphur, a low manganese, a phosphorus which is within the Bessemer limit, and a titanium. This has passed through a 20 mesh sieve. Sample C gives a medium silicon, high sulphur, medium manganese, medium phosphorus, and a titanium. This has also passed a 20 mesh sieve. Sample D gives a high silicon, low sulphur, high manganese, high phosphorus and a titanium, passed through a 20 mesh sieve.

The drillings were obtained from castings made after the plan described by Mr. West in his paper before the Pittsburg Foundrymen's Association, June, 1898, widely pub-

lished by the trade papers. The drillings were obtained under the supervision of Prof. C. H. Benjamin, and the standardizing under Prof. A. W. Smith, both of the Case School of Applied Science.

The chemists engaged in standardizing the four samples are Messrs. Booth, Garrett and Blair, Philadelphia; Prof. A. W. Smith and Cremer & Bicknell, Cleveland, Ohio, and James McCreathe, Harrisburg, Pa.

The standards are sold at the price of $5.00 per pound and in no instance will less than one pound be sold. The samples are packed in bottles, holding one-third of a pound, and delivered in cases as seen in Fig. 1, holding three or four bottles according to the desires of a subscriber. One bottle each of samples A, B, C and D can be had, or a subscriber can have three or four bottles of all one sample (excepting the sample A, which contains the total carbon and graphite, and of which only one bottle will go to any one subscriber), or two or three bottles of one sample and one of another; in fact, bottles of samples B, C and D can be sent in any proportion desired, as it is the wish of the committee to follow the desires of all purchasers, as far as in their power.

The Sherman Iron Co.
Sharpsville
Penna
American Foundrymen's Association
STANDARDIZING BUREAU
CLEVELAND, O.
Glass.
With Care.
A
American Foundrymen's Association.
Standardized Sample of Cast Iron.
The castings from which these samples were taken were made by THOS. D. WEST. Their preparation was under the supervision of Prof. C. H. Benjamin and Prof. A. W. Smith. The analytical work was carried out by Booth, Garrett & Blair, Philadelphia, Pa., Prof. A. W. Smith, and Cramer & Bicknell, of Cleveland, O., and A. S. McCreath, Harrisburg, Pa.
NOTICE.—The direction of the Standardizing Bureau of the American Foundrymen's Association is in the care of Professors C. H. Benjamin and A. W. Smith, Case School of Applied Science, Cleveland, O., who will arrange for the preparation and distribution of the standardized drillings. Business communications may also be addressed to
THOS. D. WEST, Chairman,
SHARPSVILLE, PA.

Fig. 1.

One pound of the samples should furnish enough material for 36 complete analyses or at least 200 separate determinations. The analyses of the sample, A, B, C and D will be sent separate and may be placed upon bottles or kept private as desired by the subscriber.

The amount asked for these standards, considering their cost, is very low, and the drillings such that no chemist could manufacture them for himself at many times their price. The outlay for preparing the four samples was somewhat over $400.00. Moreover, the good subscribers can do in assisting to promote greater uniformity in the work of laboratories, dealing with cast iron, is such that no matter to what part of the country any portion of the sample may be sent, like reports of analyses can be expected at the hands of careful chemists, who are only too often compelled to resort to short-cut methods in order to keep up with the work in their laboratories.

The undersigned committee is encouraged by the receipt of subscriptions, which include, to date, about thirty-five (35) of our leading laboratories. It is hoped this open letter will be so fruitful of results that another year will find few, if any, laboratories not possessing the standards herein advanced. Those wishing to assist this movement to the extent of ordering standardized samples, will please address their orders to any of the following committee:

Thos. D. West, Chairman, Sharpsville, Pa.

Dr. R. Moldenke, 46th st. and A. V. Ry., Pittsburg, Pa.

James Scott, Lucy Furnace, Pittsburg, Pa.

P. W. Gates, Gates Iron Works, Chicago, Ill.

E. H. Putnam, "THE FOUNDRY," Detroit, Mich.

Fires and Accidents.

Galen Coleman's foundry, Middletown, N. Y., was damaged by fire.

Frank Sweet's Brass Foundry, Chicago, was burned. Loss, $1,000.

The Hessell Iron Works, Colorado Springs, Col., were damaged $8,000 by fire.

The Obrien foundry at San Francisco was damaged $8,000 by fire October 14.

Robbins & Myer's foundry at Florenceville, O., was damaged $2,500; insured.

J. T. Snyder's foundry at Luzerne, Pa., was burned. Loss, $12,000; partly insured.

The Centerville (Iowa) Foundry & Machine Works were burned. No insurance.

The roof of the Heughes foundry, Rochester, N. Y., was damaged $200 worth by fire.

Fire did several hundred dollars' damage to D. M. Osborne Co's foundry at Auburn, N. Y.

The Bellaire foundry and machine shops, Bellaire, O., were destroyed by fire. Loss, $3,000.

The foundry of the Pennsylvania Agricultural Works, York, Pa., was burned; loss, heavy.

The foundry of T. B. Laycock, Indianapolis, Ind., was burned. Loss, $25,000; well insured.

The foundry of the A. B. Farquhar Co., York, Pa., burned. Loss, $10,000, with some insurance.

The Merrill Iron Works, Milwaukee, Wis., were destroyed by fire. Loss, $10,000; insurance, $4,000.

The foundry of Williams, White & Co., Moline, Ills., burned. Loss, $10,000; covered by insurance.

The Kerr-Murray Co.'s foundry at Fort Wayne, Ind., was damaged by fire to the extent of $5,000.

The foundry of J. T. Snyder, at Luzerne, Pa., was destroyed by fire. Loss, $12,000; partly insured.

The foundry and machine shops of Walter N. Morrison, Rochester, N. H., were destroyed by fire. Loss, $9,000.

The warehouse and platforms of the Tyler Foundry & Machine Co., Tyler, Tex., were burned. Loss, $10,000, with $5,000 insurance.

The machine and pattern shops of the Adolph Leitelt Iron Works, Grand Rapids, Mich., burned September 10. Loss, $30,000; insured.

In the million-dollar fire which recently devastated Colorado Springs, the foundry of Hassell-Talcott Co. was destroyed; loss, $10,000.

John Schultz, 24 years old, employed at the Brooks foundry, Cleveland, O., sustained a broken leg from the falling of a heavy piece of iron.

Fire at Buffalo, September 25, did $12,000 damage to the Bryant Iron Works, the loss being largely in patterns, and $4,000 damage to the Adirondack Bicycle Co.

A building owned by the Hanover Foundry & Machine Co., located in Hanover, Pa., and occupied by the Keystone Spoke & Binding Works Co., was burned. Loss $15,000.

Jeremiah Strausser, aged 28 years, an employe of the Reading Foundry Co., Reading, Pa., fell from the top of a large crane yesterday afternoon, a distance of 40 feet, and was instantly killed.

Mr. Obrien's foundry, San Francisco, Cal., was damaged to the extent of $8,000 by fire. There were several narrow escapes. One young man carried his step-mother to the roof, whence they were rescued by firemen.

John Borgerding was badly hurt in the St. Paul foundry by being hit by a piece of iron which flew from a casting. He was taken to the hospital, and his condition is thought to be favorable.

Ole Lee, a carpenter employed at the Bass foundry 47th and Clark streets, Chicago, met death yesterday in a manhole. He was making repairs, when his coat was caught in a revolving shaft, and he was whirled around with frightful rapidity. Every bone in his body was broken and his clothing torn off. Lee resided at 4950 Wentworth avenue.

Charles Perkins, of 19 Stearns park, a molder, who was employed at the shops of the Springfield Foundry Co., Springfield, Mass., suffered severe burns in both of his eyes by the spattering of molten metal while pouring the fluid into a receptacle. The receptacle contained some small pieces of old, rusty metal, which caused the fluid to spatter and fly into his eyes. The physician found that his right eye was dangerously burned. The doctor hopes that it may be saved. The left eye is not dangerously burned.

Personals.

T. T. Wood has resigned as manager of the Lakeside Malleable Iron Works, of Racine, Wis.

James Hall, secretary of the Springfield Foundry Co., Springfield, Mass., was married to Miss J. Maud Williams, of Sunderland.

Frank B. Ward has resigned his position as secretary and general manager of the Michigan Brass & Iron Works, of Detroit, Mich.

Thomas Wathey, recently with the Walker Company of Cleveland, O., has accepted the position of superintendent of the Hay Foundry & Machine Works, Newark, N. J.

Thomas E. Inslee has resigned as assistant superintendent of the foundry of H. B. Smith Co., Westfield, Mass. He is succeeded by Arthur A. Brown, of Champaign, Ill.

Arthur A. Brown, of Champaign, Ill., has taken the position of assistant superintendent at the Main street foundry of the H. B. Smith Company, succeeding E. Inslee, who has gone to Philadelphia.

Benj. F. Chambers, on leaving the Bausch & Harris Co.'s employ to take the position of foreman of foundry for the Farrell Tool Company, at Waterbury, Ct., was presented by his former shopmates and subordinates with a gold chain and Masonic charm at a reception in his honor.

David Spence, who recently went to Nashua, N. H., as superintendent of the Nashua Iron & Brass Foundry, has resigned his position and returned to his home in Williamsport, Pa., on account of his wife's illness. He was recognized in Nashua as thoroughly capable, and his departure is much regretted.

W. D. Sargent, of the Sargent Co., Chicago, has returned from a very successful business trip in Europe, taken in the interests of the International Brake Shoe Co. Mr. Sargent has made arrangements for the sale of the International company's products in nearly every foreign country. He reports a growing desire on the part of foreign concerns to take up American goods, and that any article of American manufacture which possesses merit will find a ready sale abroad. He is taking figures at present from American pipe manufacturers, for an English correspondent, on 32,250 tons of water pipe of various sizes, and hopes to be able to place the business in this country. The pipe is for London or Liverpool delivery.

Trade Publications.

We have received the latest catalogue of the American Emery-Wheel Works, of Providence, R. I. It is of the standard size, 6 by 9 inches, and is a very neat, well executed book, containing a complete description of the varied product in its 60 pages. It illus-

trates emery wheels and emery sticks, rubbing and sharpening tools of all shapes and sizes, floor and bench grinding machines, sectional views of many different shapes of corundum wheels, etc. There are also cuts of magnetic chucks, demagnetizers, drill and tool grinders, saw-gumming machines and a revolution counter. It contains, also, complete specifications of the goods and price lists. The wheels of this concern are all "tested immediately before shipment at a surface speed of not less than 9,000 ft. per minute, giving them a stress of 250 lbs. or more per sq. in.," thus proving beyond any question that each and every wheel is entirely free from defects or weakness before it is sent out. On page 15 is given valuable instruction for users of emery wheels. The catalogue as a whole is one of the most attractive we have seen.

The Whiting Foundry Equipment Company's catalogue, second edition, is at hand. It is of standard size, 6x9 inches. A very convenient feature is the index of contents on the outside of back cover.

The illustrations are numerous, and excellent in workmanship. Traveling pillar and jib cranes are shown, of various styles and of all capacities. Also, overhead trolleys for double beam or single "I" beam tracks; derricks and air hoists and receivers; compressed air, hydro-pneumatic and belt power elevators.

A cut of the Whiting cupola, in elevation and section, gives an excellent idea of its construction in detail. They also have small cupolas for testing purposes, and ladles of all capacities, for iron and steel foundries; cars and turn-tables, core-oven trucks and fittings, brass foundry equipments, including furnaces complete, ready for lining.

Bower's patent friction tumblers are illustrated; also tumblers to run by spur gear.

On page 36 is illustrated a novel "tumbulator," which is a tumbling mill having eccentric gudgeons, causing a "wibble-wabble" motion that moves the contents of the mill first toward one end, then toward the other, at each revolution, effecting a polish that is desirable in, for instance, frame posts for iron beds.

"A view of experimental floor for sash weights" is given in connection with the Avery molding machine.

The Whiting patent car-wheel foundry system is also illustrated; and, concerning this latter the company wishes to furnish inquirers with special circulars, giving full particulars. Then follows a miscellaneous catalogue of machinery for car-wheel and general foundries, including casting breakers, drop test machines, iron flasks for pipe founders, clay grinders and mixers, and hay rope machines.

On the last page of this excellent catalogue is represented a large converter for the Illinois Steel Company, loaded on flat car, ready for shipment. This gives a graphic idea of their capacity for heavy work.

The Whiting Company has been remarkably successful from the outset, and their expanding business attests the increasing demand for their goods.

A Reservoir Substitute for Ladle.

BY JOHN PETTIGREW.

Some time ago we were called upon to make a fly wheel which took 34 tons of iron to pour it. This may not seem a very great undertaking to those who have the facilities to do a job of this kind. But when a shop is tied up to two cranes of the

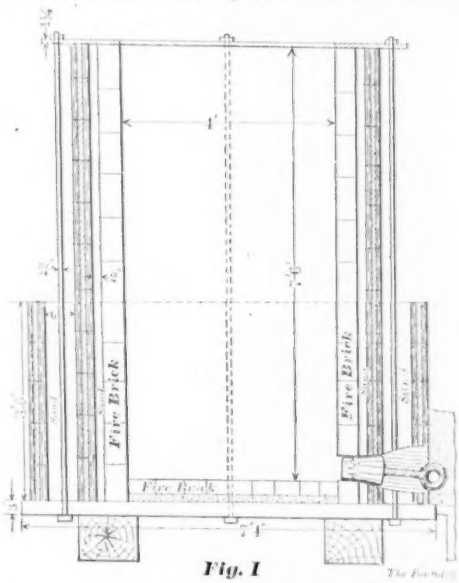


Fig. 1

old hand-power type and very slow of motion, with a ladle capacity of only 16 tons, it will be seen that some other arrangement requires to be made.

The use of a reservoir in such a case is an absolute necessity. It is the construction

of this reservoir that I wish to describe, as it may suggest to some one in the same circumstances a cheap and easy way to build one that can easily be constructed and taken apart, the plates of which can be used for a great variety of purposes in a jobbing foundry.

These plates are knuckle jointed. They are 14 inches long, nine inces wide and three-quarters of an inch thick.

The occampanying sketch will give an idea of their form. These are not a new thing by any means, as I saw them in use 38 years ago. But I have no doubt they will be new to many. They will make any size of circle required and for encasing a fly wheel or loam casting, where a pit cannot be dug, they cannot be excelled.

They are also very convenient for building runners where the gates are carried around the casting; such as drop gates for cylinders or kettles.

For the reservoir spoken of above, we made an open sand plate 7′ 4″ diameter, 3 inches thick, shown in sketch, with four lugs for bolts, on which was built the plates in a circle to the height desired. For safetly we put two layers of fire brick on the bottom, then lined the shell formed by the plates with fire brick also, leaving about two inches of space between the plates and brick, ramming the space tight with common molding sand, riddled from the floor. When all was built up, a ring with four lugs was put on, covering curbing and brick, then bolted together, making a solid vessel, which held nearly 19 tons of molten iron, good and hot for nearly three hours.

Before filling with iron the face of the brick was slushed with new molding sand and the whole thoroughly dried. The reservoir was placed so that a 5,000-lb. ladle could be poured into it, at the outermost sweep of the crane. The ladle being hoisted from the cupola and swung to place without the necessity of racking, this arrangement also keeping the crane free for any other purpose.

After the casting was taken from the foundry and shipped, a few hours sufficed to take the reservoir apart. The plates have been often used since and the brick, which were uninjured, were used for lining the cupola.

The accompanying sketch will show the general plan. The outer casing, which was built part way and rammed with common molding sand six inches from the inside or main casing, was used for a re-enforcement in case of accident, as the pressure of the liquid metal for some distance from the bottom was very great. It is always best to err on the safe side.

The fly wheel was cast with drop gates placed at regular distances all around the rim, and both runners and gates were calculated to take the iron from the reservoir fast enough so that no iron would be lost from overflow, on account of the speed with which it was delivered from the reservoir when the plug was drawn. The time taken for the reservoir to empty was less than one minute. To supply the rest of the iron needed to fill the mold there was a ladle with ten tons of iron on one crane and one with six tons on the smaller crane. These were

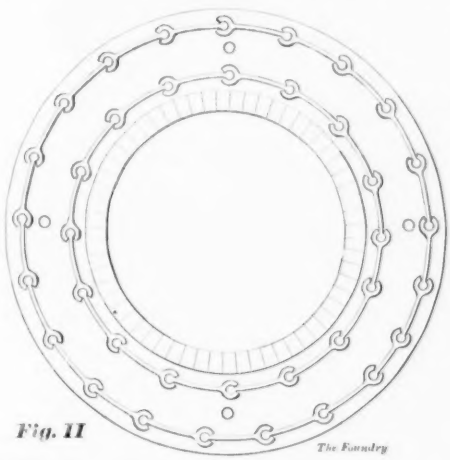


Fig. II

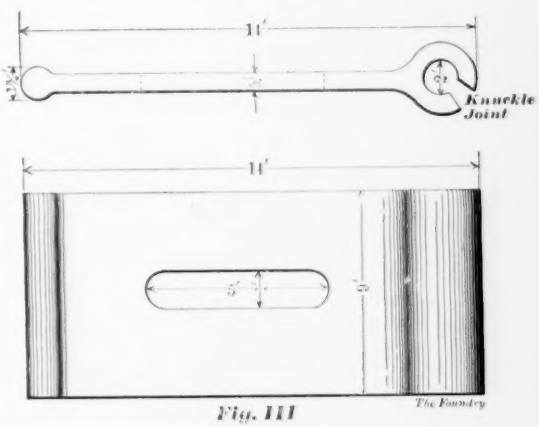


Fig. III

handled so that the runner was kept full until the mould was filled. The whole time it took to fill the mould did not exceed two and a half minutes. The above was planned by the able superintendent, W. E. Wakefield.

NOTICE!

Advertisements in this column, 30 cents a line for each insertion About seven words make a line. The Cash and Copy should be sent to reach us not later than the 20th to insure publication.

Answers addressed to our care will be forwarded.

TO SUBSCRIBERS

whose names appear on our **subscription** list, we will give one free insertion under this heading to those in want of positions, the advertisement to occupy a space of not more than five lines. Additional space or insertions must be paid for in advance at regular rates.

WANTED—Good molders. Address Kimball Bros., Council Bluffs, Iowa.

WANTED—Steady job by young molder, sober and industrious, either at molding or traveling for good foundry. Address, A, Box 447, Hanover, Pa.

WANTED—To correspond with a party capable of taking charge of a foundry making furnaces and boilers. Address E, Box 186, care of THE FOUNDRY.

WANTED—Position as foreman of foundry; experienced on both light and heavy work; can give good references. Address Box 182, care THE FOUNDRY.

WANTED—Position as superintendent or foreman of foundry by a man experienced in gray iron, floor and bench work. Address, Box 190, care THE FOUNDRY.

WANTED—Job at molding, 20 years experience, 10 on brass; good references if required. Am 36 yrs. old; wish to better my condition. Address Box 183, care THE FOUNDRY.

WANTED—Position as foreman of foundry. Familiar with general jobbing machinery and engine work; speak German and English. Good refrences. Address Box 175, care THE FOUNDRY.

WANTED—Contract work by practical foundry foreman; foundry doing line of manufacturing to operate by the ton. References. Address, with particulars, Box 188, care THE FOUNDRY.

WANTED—Position as superintendent, by practical mechanic, in foundry and machine shop; gray iron, malleable and car wheels; after Dec. 1. Address, Supt., care T. T. Wood, 1331 State st., Racine, Wis.

WANTED—Position as superintendent of malleable iron foundry. Have had large experience and can produce a superior malleable steel. Best references furnished. Address Malleable Superintendent, Box 146, care THE FOUNDRY.

WANTED—Position as foreman of foundry by young man, good habits, first-class mechanic; can handle men to best advantage, and produce at lowest possible cost; R. R. shop preferred. References. Address, Box 187, care THE FOUNDRY.

FOUNDRY FOREMAN—A bright young man, 31 years old, pattern-maker and molder, would like to take charge of foundry employing molding machines. Capable of laying out work and superintending same. Address, "Machine," Box 158, care THE FOUNDRY.

WANTED.—Position as superintendent or foreman of foundry. Have had 25 years experience in handling men, making all classes of loam, dry and green sand castings; air furnace expert; mixture for rolls, hydraulic machinery and ammonia fittings a specialty. References. Address, Box 180, care THE FOUNDRY.

WANTED—By a metallurgist, eminently successful in thorough laboratory work and in its practical application in foundry practice, permanent position. Chilled, soft and specialty castings to specifications with economy. Laboratory for sale to employers. Can influence orders for paying special work. Address Box 163, care THE FOUNDRY.

WANTED—To sell or lease: To a practical foundry man I will sell or lease my foundry and machine works at a price that will make it the chance of a lifetime to anyone with a small capital to get into business. Des Moines, Ia., is the best and largest city in the State. For particulars, address S. D. WILSON, No. 110 W. 7th st., Des Moines, Ia.

WANTED—A foundry foreman, must understand mixing metals, must also be a practical molder and understand thoroughly the making of small grey iron castings cheaply. Must be familiar with machine molding. Only reliable, capable and sober man wanted. Reply, giving age, experience and references; also, amount of salary expected. Address Small Castings, Box 185, care THE FOUNDRY.

FOR SALE—A foundry and machine shop, situated in Phillipsburg, N. J., on the banks of the Delaware River, directly opposite the city of Easton. Business established in 1872; capacity of foundry, 8 tons per day; machine shop equipped with modern tools and patterns; lot fronts on Pennsylvania R. R., 180x264 feet deep; shop makes a specialty of manufacturing the Telegraph Fodder Cutter. Address, Vulcan Iron Works, Phillipsburg, N. J.